THURSDAY, SEPTEMBER 7, 1893.

THE PUBLIC HEALTH LABORATORY.

Public Health Laboratory Work. By Henry R. Kenwood, M.B., D.P.H., F.C.S., including Methods employed in Bacteriological Research, with Special Reference to the Examination of Air, Water, and Food, contributed by Robert Boyce, M.B. Crown 8vo. 491 pages. (London: H. K. Lewis, 1893.)

AN organised laboratory for the practical instruction of students of hygiene is a comparatively novel creation, the demand for which has principally arisen in connection with the various diplomas in Public Health (D.P.H.), which are now eagerly sought after by those of the younger generation of medical men who contemplate the possibility of becoming at some future time candidates for appointments as medical officers of health. Probably there are many persons who, whilst having a general acquaintance with the studies which are pursued in ordinary scientific institutions, are yet altogether ignorant of what is being done in these public health laboratories, which have grown up within recent years. A glance at the table of contents in the work before us will at once reveal what a wide and varied field this subject of public health is made to cover, including as it does the hygienic analysis of air and water, the examination of food (milk, butter, cheese, corn, bread, meat, alcoholic beverages, mustard, pepper, sugar, coffee, chocolate, tea, and tinned provisions), together with the "methods employed in bacteriological research, with special reference to the examination of air, water, and food." That this is a very comprehensive programme will be admitted by all, whilst it is equally patent to the initiated that it is one which it must be extremely difficult for a single teacher to conscientiously undertake, involving, as it does, an adequate knowledge of the most miscellaneous subjects. Inasmuch, however, as the ground covered is mainly of a chemical nature, it is obvious that the methods of work prescribed must be such as shall recommend themselves to chemists. In this connection it is interesting to note that the student is supposed to present himself at the public health laboratory without any previous knowledge of practical chemistry, at any rate as far as quantitative methods are concerned. Thus he has even to be initiated into the mysteries of such simple contrivances as the Bunsen burner, the pipe-clay triangle, and even the homely pestle and mortar, articles with which we should have supposed that most Board School children of the higher standards were now acquainted.

The first and largest section of the book is devoted to the subject of water analysis, the practice of which appears to form the *point de résistance* of the hygienic laboratory. For the information of those who have not had the benefit of receiving their instruction in such a laboratory we will cite a few examples of the practical methods which appear to be in vogue there. Chemists will be interested to learn that in using the balance the weights should be adjusted until "the index rests absolutely in a central and vertical position!" In determining the total solid matters in water, the only drying of the residue obtained by evaporation which is advocated is to place the dish containing it "for a few minutes in the water-oven," and even this appears to be regarded as an almost excessive refinement, for we are also informed that "when recourse is not had to the water-oven, the under-surface of the dish must be always carefully wiped dry before the dish and its contents are weighed." Such instructions might have been allowed to pass had some apology been made for the necessarily crude work alone to be expected from public health students, but when a little further on we are informed that the time involved in the evaporation of 100 c.c. of water is liable to introduce error through loss of organic matter in the water, and through the access of suspended matter from the air, it is obvious that the writer is under a wholly false impression as to the degree of accuracy obtainable by the methods he describes.

For the estimation of organic matter in water, the author has recourse principally to the so-called "albuminoid ammonia" process, but since the adaptation of the Kjeldahl method to water-analysis by Drown, there is now no reason why even in a poorly equipped laboratory an accurate determination of the total organic nitrogen should not be made, in addition to that of the variable fraction of this ingredient which makes its appearance on distilling the water with alkaline permanganate. The author describes the combustion process for organic carbon and nitrogen, but as something entirely beyond the sphere of the public health laboratory. The description given of this process would not appear to be derived from personal experience, whilst the suggestion that carbonic oxide is produced in the combustion, and volumetrically measured in the subsequent gas analysis, indicates but a very imperfect notion of what a satisfactory combustion with oxide of copper should accomplish.

We hardly think that the author has been successful in giving a lucid exposition of the important and much-vexed question of the activity of water on lead, for the statement that this activity "is favoured by either neutrality or slight alkalinity of the water (acidity, however, is even more important, since it aids the power of the water to carry the lead in solution)" is surely a somewhat circuitous way of saying that the lead-dissolving power of many waters is still wrapped in much obscurity.

Again, in the description of the preparation of normal solutions for volumetric analysis we read: "The number of grammes of the reagent are weighed out and dissolved in a litre of water," an inaccuracy which is repeated on the same page in the statement that a normal solution of hydrochloric acid is one consisting of "36·37 grms. of hydrochloric acid to a litre of distilled water."

In the chapter on coal-gas we are surprised to hear that the average gas supplied by the London companies contains 3 per cent. of carbonic acid: in all the published analyses of London coal-gas, and there are many, although the analysis only of Heidelberg gas (!) is recorded in the work before us, carbonic acid is either absent altogether or only present in small traces, for the gas managers are well aware that 3 per cent. of this ingredient, so prejudicial to the illuminating power, would entail great expense in bringing the luminosity of the gas up to the parliamentary standard.

Notwithstanding some shortcomings of this kind, the

book is, on the whole, conveniently put together for the purpose it has in view, viz. the instruction of the public health student preparing for examination, for whose benefit, indeed, some of the chapters are actually furnished with schemes of analysis directing him how to make the best use of his time in the examination room.

But although this work may be well adapted to the requirements, such as they are, of the public health student, we cannot help thinking that the examples we have cited are alone sufficient to indicate the undesirability of what is in reality a very difficult branch of applied chemistry being taught outside the precincts of the chemical laboratory. In places where really accurate chemical work is not continually in progress, there must always be a tendency for rough and ready methods of analysis to creep in unchecked, with the inevitable result that a number of imperfectly trained persons are sent out into the world to undertake what ought to be regarded as highly responsible work. It is one of the most glaring anomalies of our *fin de siècle* civilisation indeed, that whilst but few educated persons would think of taking even the simplest medical remedy excepting under the advice of a duly qualified practitioner, such important questions as the water supply o a community, the detection of pernicious adulterations in articles of daily consumption, and the like, are frequently entrusted to persons who cannot furnish a shred of satisfactory evidence that they possess the necessary attainments for the performance of such responsible duties. It is deeply to be deplored, in the interests of the community, that the Institute of Chemistry has not hitherto succeeded in adequately illuminating the public on these matters. Thus, whilst the Institute has done much in prescribing educational curricula for the professional chemist, and in submitting a number of candidates to severe examinational tests, it has so far secured but little recognition for its Fellows from the general public, who certainly, as a rule, do not distinguish between them and the Fellows of the Chemical Society. In this connection, indeed, it cannot be sufficiently impressed on the laity that the Chemical Society is open, and in our opinion rightly, to *all comers who are, or profess to be, interested in chemical science*, and that its fellowship no more implies capacity to perform chemical work than fellowship of the Royal Geographical Society indicates any fitness to accompany Mr. Stanley across Central Africa, or Dr. Nansen to the Pole.

In conclusion we would point out that this type of book, embracing as it does a number of heterogeneous subjects prepared and boiled down into a sort of jelly for the pampered palate of the modern student, really raises a very important issue in connection with the much talked of technical education of the day. We perceive in the recent developments of such education a more and more marked tendency towards superficiality; year by year courses of instruction are made shorter and more composite by condensing primary subjects into a form supposed to be adapted to the requirements of particular bodies of men. All over the country we find teachers undertaking to provide a smattering in a number of different subjects, and a growing distaste on the part of students to devote time and attention to the deeper study of individual sciences. In such a subject as Public Health, the proverbial danger of a little knowledge is particularly menacing, and we are strongly of opinion that the student of this important subject, if he is to be properly trained, should receive the chemical, biological, and medical instruction involved, from a thorough chemist, a competent biologist, and a fully qualified medical man respectively, instead of imbibing only the views of a single teacher, who whilst professing a number of subjects is probably of but indifferent eminence in any one of them.

THE ARCTIC PROBLEM.

The Arctic Problem and Narrative of the Peary Relief Expedition of the Academy of Natural Sciences of Philadelphia. By Angelo Heilprin, leader of the Peary Relief Expedition. 8vo, pp. 165. (Philadelphia: Contemporary Publishing Co. 1893.)

PROF. HEILPRIN devotes almost half of his little book to the narrative of the voyage of the *Kite* to the relief of Peary, a narrative which he invests with lively interest, despite the fact that it has been anticipated by the writings of his subordinates. The record gives a very clear account of the voyage, and some admirable descriptions of Arctic scenery, supplemented by photographic reproductions printed in two tints, with a very realistic effect. Perhaps the most interesting chapter is that devoted to the naturalist of Peary's party, Mr. Verhoeff, who mysteriously disappeared just before the time fixed for returning home. A large number of men from the *Kite*, as well as Eskimos, prosecuted a minute search for several days, with the result that footprints and bits of paper were discovered on a glacier, movements on which were made difficult by the extremely rough condition of the ice. The natural inference is that Mr. Verhoeff, being alone, had fallen into a crevasse and perished there, and in this belief the search-party returned. A more romantic explanation is, however, given by some of his relatives, who believe that, enamoured of the wild life he had been leading, Mr. Verhoeff deliberately stayed behind with the object of making further explorations on his own account. Faint though the hope is, we could wish it to be true, and that when Lieutenant Peary approaches his farthest north in the new venture on which he is now embarked, he may find his old companion awaiting him.

The more important half of the book under consideration is Prof. Heilprin's clear and logical re-statement of what he aptly terms the Arctic problem. His language is frequently more perfervid than is usual amongst scientific writers on this side of the Atlantic, but his arguments are sound, and his conclusions cautious and reasonable. The discussion begins with a summary of three expeditions intended to start this summer on "the old trail" in quest of the highest latitude. On Nansen's project he wisely says little beyond stating the evidence for a transpolar current, and echoing the universal confidence in the gallant Norseman's pluck and perseverance. Nansen hopes, as our readers are aware, to approach the pole from the neighbourhood of the New Siberian Islands in longitude 140° E.

The Ekroll expedition, also a Norwegian project, has scarcely been heard about in Europe; in fact the only

other reference to it which has come under our notice is a somewhat vague allusion in the annual address on geographical progress at the Paris Geographical Society. Ekroll intended, says Prof. Heilprin, to start in June, and travel northward from Cape Mohn in Spitzbergen (about longitude 20° E.), the feature of his expedition being the use of a composite structure capable of use as boat or sledge, according to the surface which has to be travelled over. This project is shown to be at least unsatisfactory, the risk of damage to the sledge (or boat) being too great, although the route to the north is an extremely suitable one. We do not know if Ekroll has set out. The third expedition is that of Peary, who is already *en route*, and intends to work northward over the frozen surface from the north coast of Greenland, where he did such brilliant service in 1892. Of the success of this enterprise Prof. Heilprin is confident; whether the Pole is reached or not he thinks that Peary has the best chance of breaking the record, and attaining a higher latitude than any of his predecessors.

Against the common plea that polar exploration having baffled the best endeavours of men whose heroism is beyond praise, any future effort is only waste of life, Prof. Heilprin urges the incontrovertible fact that in travel the almost impossible of yesterday is the easy accomplishment of to-morrow. He remarks that the ascent of Mont Blanc, at first a feat that made a man's reputation for life, is now a common tourist's pastime, while he might have added that Spitzbergen, formerly ranking as scarcely accessible Arctic land, is now within the reach of excursion steamers.

As to the best route to the Pole, he agrees that no expedition need waste its strength again on Smith's Sound, and he criticises with some severity the conclusions of the Royal Geographical Society twenty years ago before the despatch of the *Alert* and *Discovery*. The region north of Spitzbergen where Parry attained 82°45′ in 1827, only forty miles short of the point to which steam and the scientific advance of half a century enabled the best equipped expeditions to reach through Smith's Sound, certainly appears the most hopeful, and it is that in which any new expedition on a large scale that may be planned should undoubtedly make an attempt.

Without much novelty in argument or substance, Prof. Heilprin has set forth clearly and convincingly the plain issues involved in the Arctic problem, a problem which promises to be much before the public mind for some years to come.

OUR BOOK SHELF.

Vorlesung über Maxwell's Theorie der Electricität und des Lichtes. By Dr. Ludwig Boltzmann. Part I. pp. 139. (Leipzig: Johann A. Barth.)

THIS is a most interesting introduction to Maxwell's theories about electromagnetic actions. The whole question of generalised coordinates is introduced by means of models that enable the student to make a concrete picture to himself of a particular case of what he is studying. Some people may prefer to study subjects in the most general form, but the majority find very great difficulty in working out any advance on what they are taught by others without the assistance of some concrete case. In the case of most students it certainly helps them very much indeed to be provided with simple examples. Models may often do even more than facilitate the path of the student, they have before now pointed the way for the discoverer. As the mathematical part of Maxwell's theory is so largely an application of the principles of generalised coordinates this introduction to his theory is eminently interesting and suggestive. It is perhaps more suited to the state of scientific development on the Continent than in England. German and French electrical ideas had been so bound up with Coulomb and Ampère's laws of action at a distance that even the formulæ of Weber and Clausius which postulated propagation in time did not shake their faith in action at a distance, attracting and repelling electricities and currents and poles. Even yet Poincaré cannot get over the Coulomb law foundation of electrostatics. To such ideas a dynamical foundation such as Boltzmann has given should give a new direction. The whole process by which the electric current, the electrification, the magnetic pole, appear as generalised coordinates is brought out. The only objection that can be raised to the method from a British point of view is that the method is not drastic enough. It panders to the weaknesses of those who look upon the electric current as the important thing. It almost neglects the medium. It does not emphasise the connection of electric force and displacement, magnetic force and induction. It does not go even so far as Maxwell in formulating a theory as to the nature of the medium. It is too content with symbols. It introduces the propagation of the action through the medium almost as indirectly as Maxwell does. The forces and the displacements should be the foundations of electromagnetic theory and not the equation in generalised coordinates

$$2T = L_1\dot{y}_1^2 + 2M_{12}\dot{y}_1\dot{y}_2 + L_2\dot{y}_2^2$$

We must however be content to lead people gently. Prof. Boltzmann's introduction is certainly a move in the right direction, and there is every reason to think that the exertions of him and of Prof. Hertz are rapidly turning the current of continental study of electromagnetism into the right channel. In view of Prof. Boltzmann's recent interesting remarks on the value of dynamical models, it would be well worth while translating this work of his into English as an example for us how models can be employed successfully to illustrate a difficult subject. It is only of recent years that geometrical curve plotting has been popularised as a method of illustrating and facilitating mathematical investigations, and judiciously constructed models might perform a large part of a corresponding service for dynamics in the future.

Geology: an Elementary Hand-book. By A. J. Jukes-Browne. (London: Whittaker and Co., 1893.)

VIEWED as a rudimentary description of all branches of geology, Mr. Jukes-Browne's latest treatise is highly commendable. Its 248 pages contain something about everything geological. In a few places the information is rather disjointed, but that drawback is inseparable from an elementary work of limited dimensions which aims at giving students an idea as to the wide scope of geology. Of all the branches of the science, physical geology is given the most space, and rightly, for it is the division which is most intelligible to the general reader. The majority of the illustrations are rather coarse; nevertheless, they are usually of a helpful character. An objectional feature in the text is the frequent quotations from Geikie, Agassiz, and others. It seems to us that, in general, quotations should only be permissible in matters upon which a difference of opinion exists. But, on the whole, the book is a good one, and will be useful to students of elementary geology.

Récit de la Grande Expérience de l'Equilibre des Liqueurs. By Blaise Pascal. (Berlin: A. Asher and Co., 1893.)

THIS work forms No. 2 of the new series of publications of old books relating to meteorology and terrestrial magnetism, issued in facsimile by Prof. G. Hellmann, and was first printed in Paris in 1648. There is no copy of the work in the British Museum, and Dr. Hellmann has only been able to trace three copies, two of which are in Paris, and one in Breslau. This little work is of the greatest importance to the history of physics, to meteorology, and physical geography; it gives the first conclusive proof of the pressure of the atmosphere, and puts an end to the doctrine of the *horror vacui.* This famous experiment was made at Clermont Ferrand, and on the Puy de Dôme, on September 19, 1648, so that Pascal lost no time in making his discovery public, but it is not generally known that any account had been issued prior to the publication of the *Traitez de l'Equilibre*, printed in 1663. The work is prefaced by an interesting introduction by Prof Hellmann, in which he refers to the doubt which exists whether the idea of the experiment was taken from Descartes. The latter has expressly asserted this to be the case, in two letters (dated June 11 and August 17, 1649), addressed to Carcavi, and the fact that Pascal never replied in any way to the letters in question, has induced many writers to adopt this view.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Organisation of Scientific Literature.

I HAVE followed the correspondence in your columns on the question of the organisation of scientific literature with very keen interest, and should esteem it a favour to be allowed to add a few remarks to what has been said. There are two ways in which the present disorganisation might be dealt with. The first is exemplified in Prof. Bonney's "Year-book of Science"; that is to attempt to provide a key to the present complex state of affairs in the form of yearly abstracts. But even supposing this year-book (invaluable as it is) were comprehensive, which it admittedly is not, of what use would it be to the many workers who have neither the time nor the opportunity to spend hours in first-class libraries, nor the means to buy even a tolerable number of the innumerable magazines, journals, reports, &c., dealing with their special subject.

This infinite multiplicity of publication is the root of all the evil, and "Free Lance" strikes at it hard and well in his pamphlet on the organisation of science.

This brings us to the second method. As pointed out by "Free Lance," the only true solution of the difficulty is that in each country each subdivision of science should have its one central and accredited journal in which all papers on that subject worthy of publication should be published. In fact, a centralisation of publishing, with as much decentralisation of scientific meeting as the intellectual wants of the country may need.

Were this condition of things realised, then by consulting one or two journals in each country a specialist might easily, and comparatively cheaply, keep himself abreast of current work. In addition, an annual index or indexes of the books published in the various departments of science and in various countries, would render very great service.

Briefly, and in conclusion, my view of an ideal organisation of scientific literature is somewhat as follows:—

(1) In each country one central and accredited journal for each branch or subdivision of science.

(2) An international bureau working somewhat as follows:—(*a*) In each country the (*a*) papers (*β*) books and pamphlets, published in that country to be abstracted or indexed by well-paid men. (*b*) The several countries to exchange abstracts. (*c*) Finally, each country to translate the other abstracts and indexes into its own language, and publish these along with its own abstracts in, say, quarterly or monthly volumes, classified and subdivided for each science and branch of science.

In the case of such an international bureau proving impracticable, then each journal might abstract the work done in its department in other countries, after the admirable manner of the Chemical Society.

It is to be hoped that the British Association this year will take up the question seriously and in its widest aspect. There is no use organising one portion of science and leaving the remainder in disorder. F. G. DONNAN.

Ardmore Terrace, Holywood, Co. Down, August 28.

SEVERAL of your correspondents have called attention to the importance of distributing copies of papers in quarters where they are likely to be read. It may therefore be well to emphasise the fact that the *Philosophical Magazine* refuses to supply *gratuitous* copies. When this fact is appreciated, I think most persons will see that it is rather an unbusinesslike proceeding to pay the *Philosophical Magazine* for separate copies, when they can be obtained for nothing by communicating the paper to a society.

The "full publication of . . . papers of the societies, &c.," as recommended by Mr. Trotter, would be an infringement of copyright, and would lead to the Physical Society becoming more closely acquainted with the mysteries of the Chancery Division than its members would probably desire.

The Physical Society is a young and precocious one, and, in conjunction with its partner, the *Philosophical Magazine*, would doubtless like to obtain a monopoly of all mathematical papers except those strictly denominated *pure*, which it does not care about. But its legitimate sphere of action is *experimental and applied science*, and if it shows a disposition to poach upon the preserves of its neighbours it cannot fail to excite hostility.

I do not see any objection to the word "physicist," the literal meaning of which is "naturalist"; but is not the word "scientific" more appropriate to this discussion than "physical"? A. B. BASSET.

Hotel de Russie, Ems, Germany, September 3.

Drought and Heat at Shirenewton Hall in 1893.

Rain.

Month.	1893.	Average.	Excess or defect in 1893.	Most rain in a day.	Number of rainy days in 1893.	Number of days with at least a quarter of an inch.
	Inches	Inches.	Inches.	Inches		
March	0·4	2·7	−2·3	0·170	5	0
April	0·2	2·1	−1·9	0·091	4	0
May	2·6	3·1	−0·5	0·880	9	3
June	1·8	2·6	−0·8	1·010	10	1
July	2·9	3·7	−0·8	0·660	12	4
August (to 17th)	1·8	2·1	−0·3	0·660	8	2
Total	9·7	16·3	−6·3	1·010	48	10

Since March 1, 122 days without rain.

Heat in Shade, 1893.

Month.	Number of days the heat was above		
	60°	70°	80°
April	25	9	2
May	28	15	1
June	30	21	6
July	31	21	5
August (to 17th) ...	17	17	8

Temperature, 80° and above.

Month.		°	Month.		°
April	20	82·8	July	3	83·5
,,	21	82·2	,,	6	83·5
May	12	80·0	,,	7	90·7
June	13	80·4	Aug.	9	86·7
,,	15	82·8	,,	10	83·0
,,	16	82·0	,,	12	80·0
,,	17	84·3	,,	13	86·0
,,	18	83·8	,,	14	86·5
,,	19	88·9	,,	15	88·5
July	1	86·0	,,	16	83·6
,,	2	88·0	,,	17	86·0

Most of the rain fell in thunderstorms, but their area was very limited; the amount in that of June 15 within 5 miles of this place is an example:—

Caldicot Hall	0·04	Itton Court	1·50
Dennel Hill	0·17	Piercefield Park	1·79
Wirewoods Green	0·56	The Mount, Chepstow	1·96
Shirenewton Hall	1·01		

		in.	in.
The rainfall in	May	was 2·6; of this	2·4 fell from 15th to 20th.
,,	June	,, 1·8 ,,	1·0 fell on 15th.
,,	July	,, 2·9 ,,	1·1 fell from 10th to 15th, and 1·0 on 18th and 19th.
,,	Aug. (to 17th)	,, 1·8 ,,	1·0 fell on 1st to 3rd, and 0·6 on 10th.

Thus, of the total rainfall (9·7), 7·1 inches fell on 17½ days out of the 170 days. On August 9 there was no rain, but more lightning than I had seen since the memorable storm of August 9, 1843. It commenced at 9 p.m. and lasted five hours. From very frequent counting there could not be less than 10,000 flashes (the estimate was 11,540). For three hours the most number of flashes in a minute was 121, and the least 39. Before the storm of June 15 the ground was dry to the depth of 15 inches, and this 1 inch of rain only penetrated 2 inches. The long intervals of drought have parched the ground, so that we are still suffering from want of rain.

The Drought and Heat of 1893.

The results of an unusual occurrence like the present season show as clearly as instrumental observations the exceptional character. We have a very near copy of the drought of 1868–

1870; *i.e.* Monmouthshire is repeating what in 1868–70 occurred in Nottinghamshire. Flowers and fruit have been a month earlier than usual, their period has been of short duration, and insect pests have been very great. There has been an extraordinary abundance of apples, pears, plums, cherries, gooseberries, currants, field mushrooms, butterflies, moths, flies, caterpillars, cuckoo-spit aphis, slugs, and wasps. The tree-wasp, which is rare, has had many nests, and, as the structure is not generally known, my son has taken the enclosed photograph, which clearly shows it. The tree-wasp's nest is built much earlier than that of the ordinary wasp, and equally large, a low bush being the situation usually selected. Nightingales and cuckoos have been very numerous. Grass is now being mown for hay, and four to five acres will only yield a ton, whilst the straw of corn is shorter than ever before known. Trees are also very bare of leaves. Water is scarce, as many springs have been dry for some weeks. In June the trees and shrubs were as if varnished from extensive honeydew, which the thunderstorm cleared away. Strawberries are blooming a second time, and there are many plants seeding that do not usually seed here.

E. J. LOWE.

Some Recent Restorations of Dinosaurs.

UNDER the above title, an illustrated article, by Mr. R. Lydekker, appears in NATURE, July 27, 1893, p. 302. This purports to give a summary of what has recently been done in restoring certain remarkable forms of extinct reptiles. Most of the statements made are correct, but with them are a number of serious errors that may mislead readers not familiar with the subject. As the restorations given are, with one exception, my own, and represent indirectly several years' work in the field and museum, I trust you will allow me to call attention to some mistakes in this article, which were perhaps made by Mr. Lydekker through inadvertence, or from his not having seen the specimens described.

In the introduction, the date 1878 is given for the first of my memoirs on Jurassic Dinosaurs; whereas in the previous year I described (1) the earliest of the huge Sauropoda found in America, proposing the family name Atlantosauridæ for the genera Atlantosaurus and Apatosaurus; (2) various carnivorous Dinosaurs of the present order Theropoda, including the genera Allosaurus and Dryptosaurus; (3) the Stegosauria, represented by Stegosaurus, the first American genus of the group; and (4) several small forms of true Ornithopoda, including Nanosaurus. The family Atlantosauridæ, the sub-order Stegosauria, and the genera here mentioned, were thus established by me in 1877 in the *American Journal of Science*, vol. xiv.; a small matter in itself, but the beginning of a long investigation.

The first restoration given by Mr. Lydekker, Fig. 1, is that of my *Brontosaurus excelsus*, reduced from an outline sketch published, as stated, in August, 1883; but no reason is assigned for not using, especially in a summary of recent work, my more complete restoration of 1891, which includes the results of much additional study. This figure represents a typical member of the order I have called Sauropoda, but in the text the name used is Sauropsida, a much more comprehensive term.

The second restoration, Fig. 2, called "A Carnivorous Dinosaur," is said to have been reproduced from my figures. This must be a mistake. It is evidently printed from one of my *clichés*, and is certainly used without authority. Moreover, the name I gave to the animal represented (*Ceratosaurus nasicornis*) is not even mentioned, but it is incidentally stated that my genus Ceratosaurus, based on this unique specimen, is inseparable from the European Megalosaurus. This statement could not be fairly made by anyone familiar with the type specimens of the two genera, or even with the literature. Only a few authentic remains of Megalosaurus are known, and I have studied all the important specimens with care. There is no evidence that the skulls are identical in the two forms, and much against it. The plano-concave cervical vertebræ of Ceratosaurus, unknown in any other Dinosaur, are radically different from the convexo-concave vertebræ of Megalosaurus. The complete co-ossification of all the pelvic elements of Ceratosaurus is another distinctive character, and the union of the metatarsals also is important. An elementary knowledge of the structure of Dinosaurs is quite sufficient to show any anatomist that the two belong to genera widely different, and to indicate for them distinct families. Additional remains, obtained since Ceratosaurus was described, have in great part removed the objection that the co-ossification mentioned may have been

pathological. My restoration will be found in the American *Journal of Science* for October, 1892, and in the *Geological Magazine* for April, 1893.

The third figure given by Mr. Lydekker is a reduced copy of my restoration of *Stegosaurus ungulatus*, published in August, 1891. This reptile he calls Hypsirophus, giving that name priority over Stegosaurus, but without citing any authority for such a statement. A single reference to the literature would have proved this to be a mistake, as Stegosaurus was published by me in 1877, as above stated (*American Journal of Science* (3), vol. xiv. p. 513), while the name Hypsirophus was given by Cope in 1878 (*American Naturalist*, vol. xii. p. 188). Another error of less importance is in regard to the specimen on which the restoration is based, although this was clearly stated in the description accompanying my figure. The type specimen of *Stegosaurus ungulatus* Mr. Lydekker apparently confuses with a second skeleton, of a different species, which was even more perfect when found.

The fourth restoration given is a reduced copy of my figure of the skeleton of *Triceratops prorsus*, which, like the preceding restorations, has already been published by me, both in the *American Journal of Science* and in the *Geological Magazine*. Here again Mr. Lydekker rejects my generic name Triceratops, and even puts that and another genus of mine (Ceratops) as synonyms of Agathaumas without giving any reasons for doing so. The type specimens of the literature would show any candid anatomist that the three forms named, and another which I called Torosaurus, are all distinct genera, separated by well-defined characters. These characters I have given in detail in the *American Journal of Science*, accompanied by accurate figures of the forms I have described (vol. xliii. pp. 81–84, plates ii. and iii., January, 1892).

The remaining restoration given in Fig. 5 represents a well-known skeleton of Iguanodon in the Royal Museum of Belgium. In regard to this figure I have at present nothing to say, except that I have carefully studied the original specimen and those found with it, having made several visits to Brussels for this purpose.

The omissions from this article are perhaps as noteworthy as what it contains. No reference is made to two restorations of American Dinosaurs which I have recently published; Claosaurus from the Cretaceous, and Anchisaurus from the Triassic, although each is based on a nearly perfect skeleton. Both of these restorations have appeared in the *American Journal of Science* and also in the *Geological Magazine* within the past year. Mr. Lydekker likewise omits the restoration of Megalosaurus, which he has lately given to the public, although many palæontologists would be glad to know more about it, especially about the remains on which it is based.

Mr. Lydekker begins his article by referring to the discouragements of palæontologists in the investigation of fossil vertebrates, but ends with some words of encouragement. He might have added that one discouragement to active workers who devote years to exploration and study is to have the results of their labour used without due credit, or disparaged by those who do not understand them. O. C. MARSH.

Yale University, New Haven, Conn., August 15.

Insects Attracted by Solanum.

SIR JOHN LUBBOCK, in his "British Wild Flowers in Relation to Insects," remarks (p. 133) that *Solanum* is little visited by insects. Darwin, in "Effects of Cross and Self Fertilisation," has some observations (p. 387) to the same effect. It will therefore be useful to record that, however it may be with European species, an abundant *Solanum* of New Mexico is very attractive to insects. The species in question is *S. elæagnifolium*, Cav., which has deep lilac flowers not unlike those of the potato. I was especially successful in capturing interesting aculeate hymenoptera on this plant, as the following list will show. All listed were taken in Las Cruces, and all (except the *Megacilissa*, July 12) on July 13.

Hymenoptera taken on Solanum elæagnifolium, 1893.

Ammophila pruinosa, Cr. ♀.
,, *varipes*, Cr.
Anthophora urbana, Cr. ♀.
Halictus, sp. ♀.
Megacilissa gloriosa, Fox.
Melissodes menuacha, Cr. var.? ♀
Myzine frontalis, Cr. MS.
Mysson texanus, Cr. ♀.
,, n. sp.
Odynerus bravo, Sauss. (new to U.S. fauna).
Pelopœus servillei, Lef.
Plenoculus, n. sp.
Sphœrophthalma coccineohirta, Blake, ♂ var.
Stizus agilis, Sm.
,, *flavus*, Cam. (new to U.S. fauna).
Tachysphex, sp. ♀.
Tachytes elongatus, Cr. ♂.
Trypoxylon texense, Sauss.

For the identifications of the species I am indebted to Mr. W. J. Fox. T. D. A. COCKERELL.

Agricultural College, Las Cruces, New Mexico, U.S.A. August 16.

Old and New Astronomy.

IN your notice of the "Old and New Astronomy," your reviewer has, I think, misunderstood the passage with respect to reflecting telescopes, on p. 45, which he refers to as indicating that Mr. Proctor supposed that the image in the principal focus of a reflecting telescope was affected with chromatic aberration or false colouring. Section 97, to which I conclude your reviewer refers, evidently refers to the magnified image which enters the eye of an observer when a "*real image* of an object is submitted to microscopical examination."

No one who knew Mr. Proctor could suppose him to make such a mistake; and that he was perfectly well aware that the image thrown by a reflector was not affected with chromatic aberration, would, I think, have been evident to your reviewer if he had read to the bottom of the page, where in Section 101 Mr. Proctor says:—"Newton supposed that it was impossible to get rid of this defect (*i.e.* chromatic aberration), and therefore turned his attention to the construction of reflectors," a clear proof that Mr. Proctor was in no doubt upon the subject, and only referred in the previous passage to the false colouring of an image formed by a lens. S. D. PROCTOR-SMYTH.

8 Duncairn Street, Belfast, August 23.

MRS. PROCTOR-SMYTH is in error in supposing that my note referred to Section 97 of "Old and New Astronomy." I referred to Section 100, in which the author says "the pencil of light proceeding from a point such as P, Figs. 14, 16, and 18, consists of rays of different refrangibility, and therefore *not converging to a focal point such as p but to a focal line in the axis of the pencil.*" (The italics are mine.) Fig. 18 is a diagram of the formation of a real image by a reflector. The reference to Fig. 18 may have been a slip; if so, it should have been corrected in the completed volume, as otherwise the student, reading the subsequent paragraphs, to which Mrs. Proctor-Smyth refers, is confused as to what the author really means, and is doubtful whether the reflector does or does not suffer from chromatic aberration. THE REVIEWER.

Suicide of Rattlesnake.

ANOTHER question raised by the late snake story is, How long does it take to drown snakes? Some of the non-poisonous kind at the Zoological Gardens, in certain states of the weather, are fond of hanging themselves over the edge of their tank, with their heads immersed in the water, for as long as an hour together. E. L. GARBETT.

August 29.

THE EARLY ASTERISMS.

I.

NOT very many years ago, when the literature of China and India was as a sealed book, and the hieroglyphics of Egypt and the wedges of Babylonia were

still unread, we had to depend for the earliest traces of astronomical observation upon the literatures of Greece and Syria, and according to these sources the asterisms first specialised and named were as follows:—

The Great Bear	Job (xxxviii. 31), Homer.
Orion	Job (ix. 9), Homer, Hesiod.
Pleiades, Heiades	Job (xxxviii. 31), Homer, Hesiod.
Sirius, the Great Dog ...	Hesiod (viii.), the name; Homer called it the Star of Autumn.
Aldebaran, the Bull... ...	Homer, Hesiod.
Arcturus	Job, Homer, Hesiod.
The Little Bear	Thales, Eudoxus, Aratus,
The Dragon	Eudoxus, Aratus.

It follows from the investigation into the orientation of Egyptian temples that the stars α Ursæ Majoris, Capella, Antares, Phact, and α Centauri were carefully observed, some of them as early as 5000 B.C., the others between 4000 and 3000 B.C. Further, that the constellations of the Thigh (Ursa Major), the Hippopotamus (Draco), the Bull, and the Scorpion had been established in Pyramid times.

It becomes important therefore, if we recognise this as the dawn of astronomy in Egypt, to see if any information is extant, giving us information concerning Babylonia, so that we may be able to compare the observations made in the two regions, not only with a view of tracing the relative times at which they were made, but to gather from these any conclusions that may be suggested in the course of the inquiry.

The inquiry must be limited to certain detailed points; we know quite well already, as I stated in the introduction, that the omen tablets of Sargon I., who reigned in Babylon 3700 B.C., prove unquestionably that astronomy had been cultivated for thousands of years before that date.[1] But to institute a comparison we must leave the general and come to the particular. I will begin with the northern constellations, as it follows from my researches that very early at Denderah and Thebes, and in all probability at On, temples were erected for their worship—the worship of Anubis or Set, as I have shown, that is α Ursæ Majoris and γ Draconis.

According to Maspero, Set formed one of the divine dynasties at On, and the northern stars seem to have been worshipped there. I suppose there is now no question among Egyptologists that the gods Set, Sit, Typhon, Bes, Sutekh, are identical. It is also equally well known that Sutekh was a god of the Canaanites[2] that the hippopotamus, the emblem of Set and Typhon, was the hieroglyph of the Babylonian god Baal,[3] and Bes is identified with Set in the book of the dead.[4]

It is also stated by Maspero that at Memphis[5] [time not given] there were temples dedicated to Soutekh and Baal. In the article on the circumpolar stars I have suggested that they were taken as typifying the powers of darkness and of the lower world, and I believe it is conceded by Egyptologists that Aunbis in jackal form preceded Osiris in this capacity.

In the exact centre of the circular zodiac of Denderah we find the jackal located at the pole of the equator; it obviously represents the present Little Bear.

Do we get the jackal constellation in Babylon astronomy? Of this there is no question, and in early times.

[1] Besides the book on omens we have "The Observations of Bel," or "Illumination of Bel" (Mul-lil), seventy-two books dealing with conjunctions of Sun and Moon, phases of Venus, and appearance of comets. "Hibbert Lectures," (Sayce, 1887, 29).

[2] Maspero, "Histoire Ancienne," p. 165.

[3] Pierret, "Le Panthéon Egyptien," p. 4.

[4] *Idem*, p. 48.

[5] Maspero, p. 357.

Jensen refers[1] to the various readings "jackal" and "leopard," and states that it is only doubtful whether by this figure the *god* ANU or the *pole of the ecliptic* ANU is meant. Either will certainly serve our present purpose.

I know not whether the similarity in the words Anu and Anubis results merely from a coincidence, but it is quite certain that the seven stars in Ursa Minor make a very good jackal with pendant tail, as generally represented by the Egyptians, and that they form the nearest compact constellation to the pole of the ecliptic.

It seems extremely probable, therefore, that the worship of the circumpolar stars went on in Babylonia as well as in Egypt in the earliest times we can get at.

A very wonderful thing also is that, apparently in very early times, the Babylonians had made out the pole of the equator as contradistinguished from the pole of the ecliptic. This they called Bīl. With this Jensen finds no star associated,[2] but 6000 B.C. this pole would be not far removed from those stars in the present constellation Draco, out of which I have suggested the old Egyptian asterism of the hippopotamus was formed.

Now I gather from Prof. Sayce[3] that Anu and Bīl ranked as two members of a triad from the commencement of the Semitic period, the third member being probably a southern star symbolised as we shall see in the sequel.

The whole triad was stellar and two-thirds circumpolar; it was only in later ages that we get a triad consisting of sun, moon, and Venus,[4] Venus being replaced at Babylon by Sirius.[5]

To these two northern divinities temples were built, both were worshipped in one temple at Babylon,[6] which must therefore have been oriented due north, and the pole of the equator, the altitude of which (equal to the latitude of the place) was probably in some way indicated. Here there was no rising and setting observations, for Eridu the most southern of the old Babylonian cities had about the same latitude as Bubastis, in Egypt. The pole of the ecliptic (Anu) would revolve round the pole of the equator (Bīl) always above the horizon.

So that since	Sutech = Anu
and	Baal = Bīl,

the temple at Memphis to those divinities reported by Maspero (see *ante*) must have been oriented in the same way as the one at Babylon; and if the above evidence be considered strong enough to enable us to associate the Babylonian Bīl with the Egyptian Taurt, we have not only Ursa Minor but Draco represented in the mythology both of Egypt and early Babylonia.

I gather from Prof. Sayce's "Hibbert Lectures"[7] that there is a distinct evidence of a change of thought with regard to Anu. Observations of stars near the pole of the ecliptic appear to have been utilised before they were taken as representing either the superior or inferior powers—before in fact the Anubis or Set stage *quâ* Egypt was reached. After this had been accomplished there was still another advance in which Anu assigns places to sun, moon, and evening star, and symbolises the forces of nature.

It seems probable that the same rectangular arrangement of temples which held in Egypt, held also in Babylonia,[8] and this perhaps may be the reason why Bīl seems so often to refer to the sun, whereas it was the name given to the combined worship. Sometimes, on the other hand, the worship of the stars is distinctly

[1] Kosmologie der Babylonier, p. 147 on the word, Anu.

[2] P. 147.

[3] Sayce, p. 193.

[4] Sayce, p. 193.

[5] Jensen, p. 149.

[6] Sayce, p. 439.

[7] P. 190.

[8] In the ceremonials in the temples also the statues of the gods in boats or arks were carried in procession. Sayce, p. 280.

referred to as taking place in a solar temple. Thus at Marduk's temple, E-Sagila we are told "two hours after nightfall the priest must come and take of the waters of the river, must enter into the presence of Bīl, and putting on a stole in the presence of Bīl must say this prayer," &c.[1] The temple then will have been probably oriented to the north.

Nor was this all; movements in relation to the ecliptic had been differentiated from movements in relation to the equator. We have inscriptions running:—

"*The way in reference to Anu*," that is the ecliptic with its pole at Anu.

"*The way in reference to Bīl*," the equator with its pole at Bīl.

In other words, the daily and yearly apparent movements of the heavenly bodies were clearly distinguished, while we note also

Kabal šami, "the middle of the Heavens" defining the meridian.

So far as I have been able to gather any myth like that of Horus involving combats between the sun and circumpolar star gods is entirely lacking, but a similar myth in relation to some of the ecliptic constellations is among the best known.

The Ecliptic Constellations.

I have already in previous articles pointed out that at On we seemed limited to Set as a stellar divinity; so soon as pyramid times are reached, however, this is changed.

I have given before the list of the gods of Heliopolis, and have shown that with the exception of Sit none are stellar. But we find in pyramid times the list is increased; only the sun gods Ra, Horus, Osiris, are common to the two. As new divinities we have[2]:—

Isis.
Hathor.
Nephthys.
Ptah.
Selkit.
Sokhit.

Of these the first two and the last two undoubtedly symbolised stars, and there can be no question that the temples of Isis built at the pyramids, Bubastis, Tanis, and elsewhere, were built to watch the rising of some of them.

The temple of Saïs, as I have said, had east and west walls, and so had Memphis, according to Lepsius. The form of Isis at Saïs was the goddess Neith, which, according to some authorities, was the precursor of Athene. The temple of Athene at Athens was oriented to the Pleiades.

There is also no question that the goddess Selk symbolised Antares.

We find ourselves then in the presence of the worship of the sun and stars in the constellations of the ecliptic in Egypt, in pyramid times, and in constellations connected with the Equinoxes; for if we are right above the Pleiades and Antares these are the stars which would herald the sunrise at the Vernal and Autumnal Equinox respectively, when the sun was in Taurus and Scorpion.

Now associated with the introduction of these new worships in pyramid times was the worship of the bull Apis.

The worship of Apis preceded the building of pyramids. Mini is credited by some authors with its introduction,[3] but at any rate Kakau of the second dynasty issued proclamations regarding it,[4] and a statue of Hapi was in the temple of Cheops.[5]

The first question which now arises is When were these constellations established in Babylonia? Is there any information?

1 Sayce, p. 101.
2 Maspero, *op. cit.* p. 64.
3 Maspero, *op. cit.* p. 44. note.
4 Maspero, *op. cit.* p. 64.
5 Maspero, *op. cit.* p. 46.

With regard to the constellations of the Bull and Scorpion, there does seem to be some information, and on this point in a subsequent article I shall have to refer at some length to Jensen's recent important book.[1]

J. NORMAN LOCKYER.

(*To be continued.*)

PUBLICATIONS OF THE ZOOLOGICAL STATION AT NAPLES.[2]

DURING the winter of 1876, when the Zoological Station was already a fact in brick and mortar, and my late friend, Mr. Frank Balfour, had already shown by his famous work on the Elasmobranch Development how profitable its arrangements might turn out for the progress of research in morphology, I began to busy myself with the literary phase of my enterprise. From the very beginning it had been my intention to erect not merely a simple laboratory, in which a more or less long series of "Contributions to the knowledge" of all sorts of groups or problems ought to be worked out, but to create an organisation which by its own power and weight might influence the further progress and development of morphological science in the direction of greater concentration and by production of such scientific work as could hardly be taken up and still less carried through by individual effort alone. Of course the Zoological Station ought to have its own Journal, similar to the many Journals or Zeitschriften or Archives of other and perhaps less powerful institutions or societies, but I hoped to do more than that. If my ideas of, and confidence in, the future development of the Zoological Station were right, more important productions might be expected from it, and thus it became only a question of organisation and combination of means and ends to secure such a result. I had learned by almost daily experience how difficult, almost hopeless, it was to succeed with the specific determination of all the numberless organisms, worms, crustaceans, hydroids, tunicates, &c., &c., which our fishermen brought to light day by day. Even if the library of the Zoological Station at that time had been complete enough, it would have been almost impossible to ascertain the names of all these creatures, the descriptions and figures in former works being far too incomplete and too superficial to enable even specialists of all these groups to decide which name belonged to which animal. All attempts to form a well-determined collection of any group—not excluding even the larger crustaceans, echinoderms, and medusæ—failed, and sometimes to such a degree that my assistants and myself simply felt ourselves in the midst of chaos. This may sound strange to conchologists, ornithologists, and entomologists, who can rely on splendid monographs and innumerable synopsis and similar works for classification, but it is nevertheless a deplorable fact for the marine fauna of almost all the seas. And the want is greatly felt, for the marine organisms in by far the greater number of cases require not only an outside investigation by a simple magnifying glass, but microscopical examination of anatomy and development, both embryological and larval, to state definitely to which species they belong, the sexual difference being often so great as to have given occasion to create different genera and even groups for male and female of the same species, and the larval forms in many cases being so utterly unlike the adults that they have been classified in different orders! Tornaria is now known as the larva of Balanoglossus, whereas not long ago it was

1 "Kosmologie der Babylonier," p. 315, *et seq.*
2 "Systematik und Faunistik der Pelagischen Copepoda des Golfes von Neapel," von Wilh. Giesbrecht. XIX. "Monograph of the Fauna and Flora of the Gulf of Naples," published by the Naples Zoological Station, 1892, pp. 1–831, pl. 1–54.

supposed to belong to the Echinoderms. What can be more unlike each other than male and female of *Bonellia viridis?* How long did it take to ascertain the true relation of the so-called Hectocotylus to the Cephalopods? And only a few years ago a simple appendage of a well-known mollusc, Tethys, was described as a special genus by one of the most distinguished French zoologists. Such being the difficulties it can hardly be wondered at that, for instance, the same species of a Pycnogonid has had the honour of being described under nine specific and generic names, the greater part of them even by the same author, because he ignored that male and female differed, and that their larval stages again differed from each other and from the adult.

It was then that I planned the publication of a great series of monographs under the title "Fauna and Flora of the Gulf of Naples." Several of my assistants and myself set to work, each one selecting a group of lower marine animals. The main object of these monographs was to create a firm basis for systematical knowledge, but in the meantime I left everybody free to incorporate as much of anatomy, histology, and embryology as he thought convenient, thus giving greater variety to the monographs, and leaving the authors free to follow up those lines of research for which they had the greatest interest.

I wished to lay great stress upon illustrations. In looking over the existing iconography of the lower marine animals, and comparing them with those of terrestrial animals, the inferiority of existing illustrations of the former was apparent, and especially as regards the reproduction of the colouring of the living marine organisms. Colour in animals may have relatively little scientific interest compared with structure, nevertheless it has a meaning, and its good reproduction facilitates greatly the recognition of the species. Besides, practical reasons spoke very much in favour of good coloured illustrations as a means to facilitate the sale of the monographs, which were to be published on subscription, and as the safest way for covering the great expenses which were to be incurred.

I remember in this regard a conversation which I had with the great German publisher, Wilh. Engelmann, of Leipzig, to whom I offered the commission of all the publications of the Zoological Station. When discussing the project of the "Fauna and Flora" I asked his advice as to the number of copies to be printed, and proposed myself 500. Engelmann almost fainted when I pronounced that number. "My dear friend," exclaimed he, "you are going to ruin yourself! There is not the remotest possibility of such a number! Of such costly publications as you project hardly one hundred copies are sold, and if we print 150 copies, it will be more than enough." I remonstrated, and insisted on at least 300, and as I intended to pay all the expenses, Dr. Engelmann on his side kindly reducing the cost of commission to five per cent., I felt pretty safe, to find the necessary number of subscribers in the course of time—a confidence which was not in the least shared by Dr. Engelmann, who called me a Phantast, and a Utopian—denominations to which I had already become so much used that they made hardly any impression upon me. And I have only to regret that I did not insist on my first proposition, for the first volume of the "Fauna and Flora," the monograph on the Ctenophora by Prof. Chun, has been out of print for almost ten years, and single copies are sold at double the original price.

The secret of this success consisted largely in the magnificent plates which accompanied this and the following volumes. It is true that the high scientific standard of these monographs and the low rate of subscription for them caused their sale among all the more important libraries and universities, but the large number of public and private libraries who subscribed to the "Fauna and Flora" did so partly out of sympathy for the Zoological Station, and partly out of enthusiasm for the splendid illustrations which accompany the greater part of the nineteen published volumes, and are executed in the most masterly way by the celebrated lithographic firm of Werner and Winter, at Frankfurt-on-Maine. In fact, it is not too much to say that the world-wide fame of this firm has partly been created by the first volume of the "Fauna and Flora of the Gulf of Naples," whose illustrations were all personally engraved by Mr. Winter himself.

It is doubtless true that the cost of production of these plates is very great; nevertheless, I may be permitted to state that the balance-sheet of the "Fauna and Flora" shows how justly I appreciated the chances when I began this large publication; and though since the last four or five years the number of subscribers has decreased, chiefly by death, the Zoological Station hopes, nevertheless, to continue the series of monographs in the same way for many years to come.

The volume which I have under review is a very fair specimen of the value of these plates, for I hardly say too much if I state my conviction that nowhere have illustrations of Copepoda been produced to rival those of Dr. Giesbrecht's volume. One can hardly look on the first five plates without wishing that some of these fantastical and splendid figures might find their way even beyond the range of scientific literature, and serve as decorative elements in art and industry, where birds, butterflies, and flowers already occupy such an enormous field.

Thirty years have elapsed since the appearance of Claus's well-known monograph of the free-living Copepoda. Many smaller, and even some larger works have been published in the interval, enlarging the field to such a degree that it seemed advisable to divide the whole group into several parts for a new monographical study. Dr. Giesbrecht selected the *pelagic* marine forms instead of the *littoral* ones, partly on account of their better qualification for anatomical and ontogenetical researches, partly because they are yet less known than the others, and lastly, because he thinks they include the more ancestral forms of the whole entomostracous crustaceans. The bulky volume lying before us forms only the first part of the monograph, treating the systematical and faunistical chapters. But as such it gives much more than its title announces, for not only have the pelagic Copepoda of the Gulf of Naples been examined, but the whole mass of forms resulting from the oceanic cruise of the *Vettor Pisani*, an Italian corvette, and captured and carefully preserved by Capt. Chierchia, so well known among biologists, are included in Giesbrecht's work. Altogether, this volume treats of 298 species of pelagic Copepoda; 125 belong to the fauna of the Gulf of Naples, whilst 229 have been captured by Capt. Chierchia all over the globe. If one compares the last number with that of the *Challenger* expedition, where only 85 species of Copepoda are reported, one can imagine with what industry Capt. Chierchia went to work, and how carefully Dr. Giesbrecht examined the material.

The descriptions of the author are extraordinarily detailed; nevertheless he obviates great bulkiness and repetition, having introduced abbreviations for homological parts of the body and the extremities, which are also adopted on the plates. Moreover, the single species are not described one after the other, as is usually the case, but those belonging to the same genus are treated as a whole, their differences being treated in a diagnosis and by the help of synoptical lists (pp. 706-766) and indication of the plates where their specific characteristics are figured, the determina-

tion is greatly facilitated. As to nomenclature and synonymy, Giesbrecht is very rigorous in favour of priority, thus restoring even many older names to species described by Claus. A complete list of all described species, with complete indication of bibliography, is to be found on pages 676-705. The 54 plates contain 2300 figures, drawn masterly from nature by the author himself, and the first five plates, as mentioned above, give an idea of the variety of colour and form of appendages which exists even among these small marine organisms.

The systematical views and arrangements of Giesbrecht differ considerably from those of former authors. It is well known that the near relationship of the parasitical with the free-living Copepoda has been recognised already by H. Milne-Edwards; but it was Zenker who established systematically the two great groups of Natantia or Gnathostomata, and Parasita or Siphonostomata, a division which hitherto has been universally accepted. Giesbrecht points out the difficulties with which this division meets when one considers natural affinities, and thinks it impossible to adopt the manifold varieties of the construction of the oral appendages as a fundamental basis for classification. He proposes to divide the whole class into two great groups—the Gymnoplea and the Podoplea. The Gymnoplea are to be recognised by the following characteristics:—(1) chief body division occurring between the segment of the 5th foot-pair and the genital segment; (2) abdomen without rudiments of feet; (3) 5th foot-pair of the male transformed to an organ of copulation, genital organs asymmetrical; (4) heart in most cases present; (5) female carrying rarely ovisacs; (6) extremities plentifully articulated and provided with appendages. On the other hand, the Pleopoda are distinguished by (1) chief body division before the fifth pair of feet; (2) this latter rudimentary never serving as copulation organ; (3) male genital openings symmetrical; (4) heart always wanting; (5) female carrying always one or two ovisacs; (6) extremities rather scarcely provided with articulations and appendages. The great group of the Gymnoplea is further divided into two tribes—the Amphaskandria (male with symmetrical antennæ: family Calanidæ) and the Heterarthrandria (male on one side with prehensile antenna: families Centropagidæ, Candatidæ, Pontellidæ); to the family Centropagidæ are to be numbered all the Gymnoplea of fresh water. The description of the group of the Podoplea only takes up a small portion of the present monograph; therefore our author does not enter into a more detailed discussion of its classification, especially as not only all the littoral forms but most likely all the parasites belong to this group; he divides the group into two tribes—the Ampharthrandria (first pair of antennæ of the male symmetrical prehensile organs: families Misophriidæ, Mormonillidæ, Cyclopidæ, Harpactitidæ, Monstrillidæ) and the Isokerandria (antennæ of the male similar to those of the female; genital openings of the female dorsally situated: families Ontæidæ, Corycæidæ).

The rich harvest of pelagic Copepoda made by Capt. Chierchia on the three years' expedition of the Italian corvette, *Vettor Pisani*, enabled our author not only to describe a great number of new or incompletely characterised species of former authors, especially Dana's, but it gave him the possibility of explaining his views on the geographical distribution of the group, which we will only sketch with a few words, since a larger discussion of these views is impossible on account of the necessity to enter on the general conditions of pelagic life. According to Dr. Giesbrecht there are three great districts in the distribution of the pelagic Copepoda: two arctic ones, north and south, whose boundaries are at 47° N. and 44° S., and the intermediate one. The number of species belonging to this latter one is by far the greatest, almost 85 per cent. of all known species, whilst the north Arctic contains $5\frac{1}{3}$ per cent., the south Arctic $1\frac{2}{3}$ per cent. The faunistic differences between these three districts are greater than those of the three oceans; nevertheless there occur also in the Atlantic and in the Pacific species peculiar to each of them, especially in their northern parts. Pelagic Copepoda occur down to a depth of 4000 metres, and it seems that the boundaries of the above-named three districts stretch even down to these depths. Some species seem to live in very different depths, others exclusively near the surface; whether there are such that live exclusively in greater depths has not as yet been established. The character of the fauna depending more on latitude than on longitude it seems the determining causes of their geographical distribution must depend chiefly on physical agents such as light and temperature, but since the abyssal forms in the tropical parts of the Pacific are not identical with those of the northern and southern seas, which live on the same conditions of light and temperature, the difference in the three faunistic districts must be explained in part by still other causes. The distribution of other holopelagic animals seems to be identical with those of the Copepoda. According to Giesbrecht one seems to be justified in attributing the causes of the daily vertical wandering of pelagic animals to the influence of light, whilst the annual wanderings depend on temperature; besides these periodical wanderings some pelagic Copepoda seem to exist as eggs in greater depths and go slowly to the surface after their Nauplius stage.

I refrain from entering here into any greater details of the 831 large quarto pages of the volume lying before me, expressing only the hope that Dr. Giesbrecht may soon be able to publish his anatomical and embryological researches on the same group in a second volume. But as editor of the "Fauna and Flora," I may be permitted to congratulate the Zoological Station and science in general on the production of this volume, which answers fully to the programme of the whole series of monographs.

I may be permitted to state here that another big volume, treating of the Gammaridæ of the Gulf of Naples, and prepared by Prof. Della Valle, of the University of Modena will soon follow the Copepoda of Giesbrecht, and will examine in a complete way these interesting crustaceans, including their embryology and anatomy. Splendid plates accompany also the work of Della Valle, and will give perhaps for the first time the varied and remarkable natural colouring of these creatures, generally only figured in outline and diagram by former authors.

After Della Valle's monograph a large, highly interesting, and most complete monograph of the Enteropneusta (Balanoglossus), by Prof. Spengel (Giessen), will be published. Most likely both these volumes will appear this year. A very large work on the Cephalopods by Dr. Tatta is in preparation, and its first volume, containing the classification and grosser anatomy, accompanied by most splendid plates, is nearly ready. A monograph by Dr. Bürger of Göttingen, treating the Nemerteans is ready in MSS., and the Ostracods by Dr. W. Müller of Greifswald, are in the press; the Hirudinea by Prof. Apathy, of Klausenburg, have been in hand for five years, a botanical monograph treating the Rhodomeleæ, by Prof. Falckenburg, of Rostock, is near completion Prof. Ludwig will contribute several volumes on the Echinoderms of which most marvellous drawings by the artist of the Zoological Station, Mr. Mercoliano have been prepared, and several other authors are engaged on other groups.

Some years ago a discussion took place at the British Association, whether it would be right to continue the grant for a table, and it was questioned whether the Zoological Station at Naples was really destined for research and not rather an educational institution; if it were necessary to strengthen the arguments in favour of the first statement, I think the enumeration of the monographs of the

"Fauna and Flora of the Gulf of Naples," either already published (Dr. Giesbrecht's monograph is the nineteenth volume published) or in preparation may convince also those who may still be doubtful in this regard.

Later, and in another article, I may be permitted to discuss some questions regarding another great publication of the Zoological Station, the *Zoologischer Jahresbericht*, a discussion which will touch some of the most vital questions of scientific organisation.

ANTON DOHRN.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

FURTHER information has been forwarded since the last issue of NATURE from Presidents and Recorders of Sections, of which the following statement is a summary:—

In Section B the following papers are promised, in addition to those already mentioned:—"The Action of Permanganate on Sulphites and Thiosulphates," by G. E. Brown and W. W. J. Nicol; "The Relation existing between Chromium and Certain Organic Acids, and some New Chromoxalates," and on "The Action of Phosphorus Pentachloride on Urethanes," by Emil A. Werner; "The Occurrence of Cyanonitride of Titanium in Ferromanganese," by T. W. Hogg; "Hydrogen Flame-cap Measurements, and the Adaptation of the Hydrogen-flame to the Miners' Safety-lamp," by Prof. Frank Clowes. A general statement of the arrangement of work in this Section appeared in last week's NATURE. The only probable alteration is the shifting of M. Moissan's demonstration to Friday, September 15, and of the Bacteriological discussion to Monday, 18.

An interesting paper is promised to Section E by Mr. Cope Whitehouse, a distinguished American citizen of New York and Cairo.

The presidential address in Section F, on "The Reaction in favour of the Classical Political Economy" will be mainly inspired by the idea that the principles and methods of the classical and orthodox economists have only been modified and supplemented, not displaced, by recent writers; and that both theoretically and practically there are signs of a reaction in favour of the older doctrines as against socialism.

The probable arrangement of work in Section H is as follows:—On Thursday, September 14, the President's address will be delivered, and a few papers on physical anthropology will be read. On Friday, 15, Dr. Hans Hildebrand, Royal Antiquary of Sweden, will read his paper on "Anglo-Saxon Remains, and the Coeval Ones in Scandinavia," and this will be followed by archæological papers. On Monday, 18, various papers will be taken. On Tuesday, 19, Dr. Munro will describe "The Structure of Lake Dwellings," and Mr. Arthur Bulleid will give an account of "The Recently Discovered Lake or Marsh Village near Glastonbury."

Papers which have not been already mentioned in Section H are—"Anthropometric Work in Schools," by Prof. Windle; "The Prehistoric Evolution of the Theories of Punishment, Revenge and Atonement," by Rev. G. Hartwell Jones; "Pin-wells and Rag-bushes," by Mr. Hartland; and "The Tribes of the Congo," by Mr. Herbert Ward.

The Local Secretaries wish to announce that the local programme and the list of hotels and lodgings are ready for issue, and may be obtained by application at the British Association Office, Guildhall, Nottingham, until September 9; after that, application should be made at the Reception Room, Mechanics' Institution. It may also be stated that the local committee has engaged the Theatre Royal for Wednesday night, September 20, when Mr. Wilson Barrett's Company will give the new play "Pharaoh." It is hoped that members will avail themselves of the invitation extended to them for this entertainment, and that it will induce them to remain in Nottingham, and take advantage of the excursions arranged for the following day. Other items worthy of mention are a special concert, which will be given by the Nottingham Sacred Harmonic Society on the Saturday night; and a garden-party, given by Mr. J. W. Leavers, in whose grounds some of the old rock-dwellings of Nottingham are to be seen. Geologists and naturalists will be interested to know that amongst the special local literature will be a little book entitled "Contributions to the Geology and Natural History of Nottinghamshire," which has been edited by Mr. J. W. Carr, M.A., with the assistance of local specialists.

FRANK CLOWES.

SCIENCE IN THE MAGAZINES.

SCIENCE makes a poor show in the September magazines. There are, however, one or two important articles which claim attention. In the *Contemporary Review* Prof. A. Weismann writes on "The All-Sufficiency of Natural Selection," his essay being an answer to two articles by Mr. Herbert Spencer directed against Prof. Weismann's views on heredity and natural selection. The essay is not merely controversial, but also a clear explanation of Weismannism. The following is the concluding paragraph:—

> I hold it to be demonstrated that all hereditary adaptation rests on natural selection, and that natural selection is the one great principle that enables organisms to conform, to a certain high degree, to their varying conditions, by constructing new adaptations out of old ones. It is not merely an accessory principle, which only comes into operation when the assumed transmission of functional variations fails; but it is the chief principle in the variation of organisms, and compared to it, the primary variation which is due to the direct action of external influences on the germ-plasm, is of very secondary importance. For, as I previously said, the organism is composed of adaptations, some of which are of recent date, some are older, some very old; but the influence of primary variations on the physiognomy of species has been slight and of subordinate importance. Therefore I hold the discovery of natural selection to be one of the most fundamental ever made in the field of biology, and one that is alone sufficient to immortalise the names of Charles Darwin and Alfred Wallace. When my opponents set me down as an ultra-Darwinist, who takes a one-sided and exaggerated view of the principle discovered by the great naturalist, perhaps that may make an impression on some of the timid souls who always act on the supposition that the *juste-milieu* is proper; but it seems to me that it is never possible to say *a priori* how far-reaching a principle of explanation is: it must be tried first; and to have made such a trial has been my offence or my merit. Only very gradually have I learned the full scope of the principle of selection; and certainly I have been led beyond Darwin's conclusions. Progress in science usually involves a struggle against deep-rooted prejudices: such was the belief in the transmission of acquired characters; and it is only now that it has fortunately been overcome that the full significance of natural selection can be discerned. Now, for the first time, consummation of the principle is possible; and so my work has not been to exaggerate, but to complete.

Two articles of scientific interest appear in the *Fortnightly Review*. One, by Mr. W. Bevan Lewis, on "The Origin of Crime," deals with drunkenness, insanity, epilepsy, and similar affections in their mutual relationship to crime; in the second, entitled "The Climbing of High Mountains," Mr. W. M. Conway enthusiastically supports mountaineering in unexplored regions. Ordinary official surveys do not supply the detailed information with regard to buttress and fold in which resides the clue of mountain structure. It is for mountaineers to make up the deficiency.

In Mr. Conway's words:—

The Arctic and Antarctic regions remain for the future, and so do almost all the great mountain ranges in the world. The Alps alone are explored. The exploration of the Caucasus has been well begun, perhaps half done. Mr. Whymper has accomplished as much as one man can do in a season in the great Andes of Ecuador, but the Andes as a whole are little known. A good deal has been done in parts of the Rocky Mountains. Our New Zealand fellow-countrymen have boldly attacked the beautiful mountain fastnesses which belong to them. All these are hopeful beginnings, but the mountains of Central Africa and all the ranges of Asia are practically unknown. Thus the future of exploration is in the hands of climbers. The exploration of the Alps is a mere specimen on a small scale of the greater work which remains to be accomplished over areas incomparably vaster, and amongst ranges loftier and far more difficult than the Alps. . . . . Whilst the Himalayas have been in large part surveyed by the Indian Government, they are not, from a mountaineer's point of view, surveyed at all. No attempt has been made to give a true physical representation of the highest levels. The glaciation has been treated in the vaguest fashion and upon the ditch theory. From such work a mountain student cannot learn much. It was for this reason that I was tempted to make, in the year 1892, an expedition into the Karakoram Mountains, where are gathered together the mightiest group of glaciers in the world outside the Polar regions. The Hispar, the Biafo, and the Baltoro glaciers had for me the attraction of size as well as remoteness. The Hispar glacier was unsurveyed. The lower portions of the other two had been mapped by Colonel Godwin-Austen years ago, but their upper regions were unknown. The journey that I planned was duly carried out and resulted in the physical survey of some three thousand square miles of high mountain country. A map of the Central Asiatic mountain region lies before me as I write. It measures twelve by fifteen inches, On the same scale, the portion surveyed by me measures less than a square inch. This will give some idea of the amount of work that remains to be done in Asia by mountaineers.

The great difficulty in climbing at considerable altitudes lies in the diminished atmospheric pressure. Says Mr. Conway:—

It is more felt in hollow places than on ridges, more on snow than rocks, more in still air than a breeze, more in sunshine than under clouds or by night. It seems probable that the healthy human body can be accustomed to altitudes up to 18,000 or 19,000 feet. Above 19,000 feet a cumulative effect of discomfort is produced.

Mr. Conway and his party reached an altitude of 22,500 feet in the journey to the Karakorams referred to above, and he thinks an altitude of 24,000 feet may eventually be attained, but it will probably not be much exceeded.

Miss A. R. Taylor describes her sojourn in Thibet in the *National Review*.

Scribner's Magazine contains an interesting article on "The Tides of the Bay of Fundy," by Mr. Gustav Kobbé. Who has not heard of these tides, and wondered at their reputed magnitude? Statistics regarding the range are often so loosely stated that the following quotation is justifiable:—

At Grand Manan the fall is from twelve to fifteen feet, at Lubec and Eastport twenty feet, at St. John from twenty-four to thirty feet, at Monckton, on the bend of the Pelitcodiac, seventy feet, while the distance between high and low water mark on the Cobequid River is twelve miles—the river actually being twelve miles longer at high than at low water.

Under the title, "The First Artists of Europe," the Rev. S. Baring Gould gives, in *Good Words*, a well-illustrated description of the flint implements and tools, carvings on bone, horn, and ivory, sculptures, engravings, and sketches left by prehistoric reindeer hunters in caves, and beneath overhanging rocks in the valley of the Vézère, France. "The Story of the South African Diamond Fields" is told by the Rev. John Reid in the same magazine, and Mr. E. W. Abram contributes a biography of the Rev. F. O. Morris, whose volumes on "Birds" and "Butterflies and Moths" are known to all naturalists, and earned for him the name of "Gilbert White of the North."

"Bacterial Life and Light" is the title of an article by Mrs. Percy Frankland, in *Longman's Magazine*, in which the recent work that has been done on the bactericidal action of sunlight is brightly described.

NOTES.

MR. SCOTT ELLIOT has obtained a grant from the Government Grant Committee of the Royal Society for the purpose of exploring Uganda. We understand that his intention is to start from Mombassa and proceed direct to Lake Victoria Nyanza. After a short stay near the lake Mr. Scott Elliot hopes to leave for Ruwenzari, and to spend as long a time as his funds permit in exploring the botany, geology, and natural history of this mountain chain. Both Dr. Stuhlman and Dr. Baumann have been very lately in this neighbourhood, but still something of interest may be expected from Mr. Elliot's exploration.

THE works of the Cataract Construction Company at Niagara Falls are rapidly approaching completion. The tunnel is really finished, and so is the canal. The wheel-pits have had to be cut out of the solid rock. A power house is now being constructed to carry a travelling crane worked by an electric motor, the current for which will be supplied by a Westinghouse Engine and dynamo. The first of the three turbines of 5,000 horse-power has been made by the Morris Company, of Philadelphia, from designs by Faesch and Picard, of Geneva, and will be set up as soon as the electric crane is in its place. Prof. George Forbes, F.R.S., the electrical consulting engineer to the Cataract Company, has completed the plans for the electrical transmission, which will be by an alternating current. Vertical-shaft dynamos, each of 5,000 horse power, and capable of giving current in one or two phases, will be employed. It is hoped that the first of these dynamos will be built in about four months. The power will first be used at the new works of the Pittsburg Reduction Company, on the road towards Buffalo, for the production of aluminium. To hold the conductors, a roomy subway of concrete is being constructed. Cast-iron frames are built into the concrete, and brackets are fixed to them carrying insulators upon which the conductors will be supported. It will be seen from this that all the work is now well advanced, and a difficult enterprise is being brought to a successful termination.

THE exceptionally heavy cyclone which swept along the American coast on August 28 and 29, and was noted in our last issue, occasioned great loss of life and property both at sea and on land. The principal violence of the storm appears to have occurred in Georgia and South Carolina, and the fury of the wind completely swept down houses which were in the track of the hurricane. The storm was also accompanied by a tidal wave, which added immensely to the destruction on the sea-coast and on the islands in the main track of the disturbance. The wind is reported to have attained a velocity of 120 miles an hour, but much yet has to be learned from the numerous meteorological stations situated in or near to the storm's path. The cyclone was evidently an ordinary West Indian hurricane, which storms are not of uncommon occurrence at this season of the year; but it is unusual for these disturbances to maintain their full energy when they continue their course to the northward, and extend to regions well outside the tropics. This hurricane is said to have been experienced in the Bahamas three or four days before it broke with such fury on the shore of the mainland, and it is reported to have finally retreated out to sea as an ordinary gale. Just ten years ago a very severe storm traversed the south of England, and by means of ship's obser-

vations over the North Atlantic the disturbance was tracked from the tropics, along the coast of the United States, and eventually to our own shores. Doubtless the Weather Bureau of the United States will undertake a thorough and exhaustive study of the cyclone which has but just occurred.

ON the 28th ult. a hurricane passed over the more northerly of the Azores Islands, and caused great damage.

THE Rev. Leonard Blomefield, father of the Linnean Society, died at Bath on September 1, in his ninety-first year.

AN International Exposition will be held in the city of San Francisco, State of California, beginning on January 1, 1894, and continuing for six months. The general classification will be as follows:—Department A—Agriculture, food and its accessories, forestry and forest products, agricultural machinery and appliances; horticulture, viticulture, and pomology; fish, fisheries, products and apparatus of fishing. Department B—Machinery; mines, mining, and metallurgy; transportation—railway, vessels, vehicles; electricity and electrical appliances. Department C—Manufactures; liberal arts—education, literature, engineering, public works, constructive architecture, music and the drama; ethnology, archæology; progress of labour and invention. Department D—Fine arts: painting, sculpture, architecture, decoration. Department E—Isolated and collective exhibits. Mr. M. H. de Young is the Director-General and President of the Executive Committee, and all applications for space, &c., must be made to him, addressed Director-General, California Midwinter International Exposition, San Francisco, California, U.S.A.

IT is a custom to break clay vessels as a funeral rite in modern Greece, and there are proofs of the existence of similar customs among various Asiatic, African, American, and Australian peoples. Prof. N. G. Politis has investigated the origin of the practice (*Journal of the Anthropolgical Institute*, August), and has been led to conclude that it is connected with the purifications which now, as of old, form part of the funeral ritual. In a great many places, people on returning from a funeral or visiting a house of mourning, wash their hands, or are purified in some way with water, the vessels and towel used being afterwards destroyed. Prof. Politis is therefore of the opinion that the breaking of vessels is based upon two leading notions: (1) that everything used in the ritual of purification ought to be destroyed, lest the efficacy of the purificatory act be annulled through the profane use afterwards of things employed in its performance; and (2) that objects given to the dead must be destroyed, to guard against the possibility of their use for other purposes which annul their dedication to the dead, the belief being that all chattels must perish by fracture or mutilation of some kind in order to serve the purpose of a dead person, becoming through such mutilation unfit for living use.

IN "Midsummer Night's Dream," Shakespeare refers to "Russet-pated choughs many in sort, rising and cawing at the gun's report," but there appears to be a difference of opinion among ornithologists as to the bird so distinguished. So far back as 1871 Mr. J. E. Harting, in his "Ornithology of Shakespeare," interpreted the expression as meaning the gray-headed jackdaw, but the reviewer of the book in these columns remarked at the time that "without doubt the poet had in his mind the real Cornish chough, and the expression is quite accurate. 'Russet-pated' is having red *pattes*, or feet (*e.g.* the heraldic *croix pattée*, not a red *pâte* or head), a feature equally inapplicable to chough or daw, while the red feet of the former are as diagnostic as can be." Mr. Harting returns to the subject in the *Zoologist* for September, and, in support of his view that the gray-headed jackdaw, and not the red-legged chough, is referred to, brings forward evidence to show (1) that the name *chough* was not exclusively bestowed upon the bird with red bill and red legs, but was also applied to the jackdaw; (2) that "pated" means "headed," and cannot be read "patted" for "footed"; (3) that "russet" is not red, though it may be reddish and is often used for gray; and (4) that the habit of the birds referred to by Shakespeare as "many in sort, rising and cawing," indicate a mixed flock of jackdaws and rooks, and not choughs and rooks.

WE have received from the *Deutsche Seewarte* vol. xv. of *Aus dem Archiv*, containing the report upon the work of that institution for the year 1892. In the department of maritime meteorology, especially, much activity has been shown, notwithstanding the serious obstacles experienced by the lamentable cholera epidemic. The various publications under this head include sailing directions for the Indian Ocean, daily synoptic weather charts for the North Atlantic (in conjunction with the Meteorological Institute in Copenhagen), and the collection of observations made beyond the sea. The observations received from ships alone amounted to an aggregate of 192 years, and these are used in the discussion of the meteorology of the ocean, which for this purpose is divided, according to the usual practice, into squares of ten degrees of latitude by ten of longitude. The department of weather telegraphy is also conducted with marked activity, and daily and monthly reports are regularly published. In addition to these operations, and the testing of numerous meteorological instruments and chronometers, many valuable discussions are undertaken, some of which are contained in the monthly *Annalen der Hydrographie*, &c. We shall refer later on to one or two of the special discussions included in the present volume.

As regards the behaviour of pathogenic forms in vegetable tissues, Russell states that, with but few exceptions, they were unable to exist for any length of time under these conditions. Lominsky, however, who conducted no less than 300 experiments on the vitality of anthrax, the typhoid bacillus, and staphylococcus pyogenes aureus in plants (Wratsch 1890), found that these organisms were not only able to exist but to multiply. Of especial interest was the behaviour of the anthrax bacillus when inoculated into agapanthus leaves. The bacilli grew into long threads, and at the end of seven days signs of spore formation were detected, both spores and threads being found later, not only at the point of inoculation, but within the healthy cells of the soft part of the leaf; moreover, after forty-two days' residence in the leaf, their virulence, as shown by inoculation into animals, was in no way impaired. Although saprophytic bacteria, as well as pathogenic forms, have not so far been found capable of inducing any disease in plants when artificially introduced, yet bacteria have been isolated which are especially pathogenic to plants. Amongst these may be mentioned the *B. hyacinthi* of Wakker affecting the bulbs and leaves of hyacinths, and the more recent *B. hyacinthi septicus* of Heinz, which affects also the flower clusters. The pear blight has been traced to a distinct bacillus, and Savastano describes a bacillus (*B. oleæ-tuberculosis*) causing destruction of tissue and formation of spaces in the tissue of numerous fruit trees, whilst closely allied to this form is a bacillus which produces tumours on the Aleppo pine. The list, although limited, is receiving constant additions, and there is a wide field open for researches on the bacterial diseases of plants, which may, moreover, be prosecuted without the intervention at present of the anti-vivisectionist!

HERR F. VON HEFNER-ALTENECK, in the *Electrotechnische Anzeiger*, makes a provisional statement about a system of electric control of clocks which appears likely to solve this much-attempted problem in a satisfactory manner. The main difficulty up to the present has been the necessity for a special

wire system, central station, and attendance, the cost of which could not be defrayed by the limited public likely to require a luxury of this sort. Whenever, on the other hand, an enterprise was started with faulty mains and insufficient staff, the system was doomed to fail and to create a prejudice against the principle itself. All these difficulties are avoided by incorporating the control system with the electric light or power installation already existing. This is done by means of a clock invented by Herr von Hefner-Alteneck, which is placed in circuit like an ordinary incandescent lamp. It is kept wound up by the current, at an annual cost not exceeding that of one 16-candle lamp burning for ten hours, *i.e.* about 4*d*. In case of interruption of circuit, the clock will go about twelve hours independently of the current. The control is effected once a day by a momentary drop of the circuit potential by about 6 or 10 volts at 5 A.M., which has the effect of pointing all the clocks in the circuit at 5. The effect upon the lamps is inappreciable. The control can be performed by hand in the dynamo room, or automatically through the assistance of an observatory. The General Electric Company of Berlin proposes shortly to embody the system in its enterprises.

MESSRS. GAUTHIER-VILLARS have issued their quarterly list of new publications.

WE have received the Transactions and Proceedings of the New Zealand Institute, vol. xxv. 1892.

THE report and proceedings of the Manchester Field Naturalists' and Archæologists' Society has been issued for the year 1892.

THE Geological Survey of Alabama has issued a report, by Mr. A. M. Gibson, on the "Geological Structure of Murphree's Valley." The report deals particularly with the mineral resources of the region.

THE University Correspondence College Press has published the fourth Intermediate Science and Preliminary Scientific Directory, containing the papers set at the examinations in July last, and the answers fully worked.

THE Toynbee Hall Natural History Society recently organised an excursion to Jersey. Seventeen members took part in the expedition, and represented three sections—Botany, Geology, and Zoology. The whole of the coast and much of the interior was visited. At the monthly meeting of the Society, held Monday, September 4, many of the results of a fortnight's natural history work in the island were exhibited.

TWO new volumes have been added to the Aide-Mémoire series edited by M. Léauté, and published by Messrs. Gauthier-Villars and M. G. Masson. "Accidents de Chaudières," by M. F. Sinigaglia, deals with the causes and prevention of boiler accidents, and M. H. Laurent, in his "Théorie des Jeux de Hasard," gives a number of problems connected with games of chance.

MESSRS. JOHN BARTHOLOMEW AND CO., Edinburgh, have published a "Naturalists' Map of Scotland," showing (*a*) Faunal divisions and lighthouses; (*b*) Height of land and depth of sea; (*c*) Deer forests and salmon rivers; (*d*) Areas of moorland, hill pastures, and other uncultivated lands; (*e*) Areas of cultivated land. The map is excellently lithographed, and will doubtless be appreciated by the tourist as well as by the naturalist.

MR. WILLIAM F. CLAY, Edinburgh, has published, as an Alembic Club reprint, the two papers by Cavendish, which appeared in the *Philosophical Transactions* under the title "Experiments on Air." The first paper appeared in 1784, and contains an account of Cavendish's researches into the composition of water; the second paper, published in the following year, contains the description of his discovery of nitric acid.

IN 1891 a biological survey of parts of California, Nevada, Arizona, and Utah was conducted by the U.S. Department of Agriculture, Dr. C. Hart Merriam being in charge. The second part of the report on the results of this—the Death Valley Expedition—has just been published, and forms the seventh number of "North American Fauna." It consists of the special reports on birds, reptiles, batrachians, fishes, molluscs, insects, and the shrubs of the desert region, cacti and yuccas. The first part of the report, containing the narrative of the expedition, discussion of life-zones, and the list of mammalia, has not yet appeared.

TOO great praise cannot be given to the authorities of the Natural History Museum for the excellent series of guide-books that are being issued from time to time by the various departments. The latest addition to this series is a guide to Sowerby's models of British Fungi in the department of botany, prepared by Mr. Worthington G. Smith. The Sowerby collection was acquired by the Museum in 1844, and consists of more than two hundred models made of unbaked pipeclay. Mr. Smith's description of the fungi should be widely distributed, for it will enable the public to distinguish easily the edible and poisonous species.

THE benefits derived by science from the Smithsonian Institution are almost incalculable. Memoirs, monographs, and bibliographies of a most important character are distributed to private individuals and libraries with so free a hand that every one interested in the matters with which they deal must learn of their publication. A very important volume has recently been received from the institution; it is "A Select Bibliography of Chemistry," by Mr. Henry Carrington Bolton. The volume gives the titles of practically all the books on chemistry published in Europe and America between 1492 and 1892. It contains works in every department of both pure and applied chemistry. Academic dissertations, however, and theses, are not, as a rule, included, neither is the voluminous literature of periodicals. The works are arranged into seven sections as follows:—(1) Bibliography, (2) Dictionaries, (3) History, (4) Biography, (5) Chemistry, pure and applied, (6) Alchemy, (7) Periodicals. Section v. is more extensive than the other six combined. Besides pure chemistry, the book comprises works in every department of chemistry applied to the arts, but not to the arts themselves. In each section, with the exception of those of biography and periodicals, the titles are arranged alphabetically by authors. Altogether, 12,031 titles have been indexed, of which 4507 are in German, 2765 in English, and 2141 in French. In addition to the author's index, there is a subject-index which very considerably facilitates reference. For the conception of the bibliography and the completion of a stupendous work, Mr. Bolton deserves the thanks of all chemists. A debt of gratitude is also due to the Smithsonian Institution for publishing so useful a volume.

A FURTHER communication upon the manufacture of oxygen from the air by the agency of calcium plumbate, Ca_2PbO_4, the compound formed by lime with peroxide of lead, is contributed by Herr G. Kassner to the current number of the *Chemiker Zeitung*. Oxygen is now so important a commercial article that any new mode of advantageously preparing it upon a large scale must of necessity be of considerable interest. The success of the "Brin" method of isolating it indirectly from the atmosphere by the agency of barium peroxide has given rise to several attempts to discover some other substance capable of yielding oxygen of an equal degree of purity and under equally favourable conditions as regards cost of plant and working. Calcium plumbate would appear to possess several properties capable of rendering it an efficient substitute for barium peroxide, and Herr Kassner even claims for it a distinct superiority.

Whether this be indeed the case or not, can of course only be tested by actual working during a sufficiently long period of time. The method as described by Herr Kassner is briefly as follows. Calcium plumbate in the form of spongy porous pieces is first exposed to the action of moist furnace gases, which have been previously well washed, at a temperature not exceeding 100° C. The calcium plumbate under these conditions rapidly absorbs the carbon dioxide contained in the furnace gases, becoming thereby decomposed with formation of calcium carbonate and free peroxide of lead; that is to say, the acid properties of carbon dioxide are superior to those of lead peroxide, and so the former expels the latter from its state of combination with lime. This decomposition is unaccompanied by any change of form, the spongy pieces of material remaining precisely the same in shape and texture, like the pseudomorphs of mineralogy. The product of this first operation, when fully saturated with carbon dioxide, is transferred to a strongly constructed retort heated to redness, when oxygen is rapidly disengaged. The evolution of the oxygen is facilitated by leading superheated steam through the retort. When the peroxide of lead has yielded up most of its available oxygen, carbon dioxide commences to be evolved, and subsequently the issuing gas is pure carbon dioxide, which is collected separately. The carbon dioxide evolved during the intermediate phase is removed from the oxygen by allowing the gases to pass over a further quantity of calcium plumbate, which absorbs it entirely, allowing only pure oxygen to escape. The last phase in which pure carbon dioxide is evolved is carried on to completion, after which the residue is readily reconverted into calcium plumbate, for use in a subsequent operation, by driving a current of air through the retort.

IN addition to Kassner's process, above described, another has been patented by Peitz, in which instead of furnace gases pure carbon dioxide is employed. Le Chatelier has also recently published a paper upon the subject, in which, however, he does not appear to have been acquainted with the whole of Kassner's publications. Le Chatelier concludes that calcium plumbate gives up its available oxygen by merely heating it to a temperature of 200° higher than that employed in Brin's process in the case of barium peroxide, and that the heated residue absorbs oxygen from the air again much more rapidly than the latter substance. Kassner has already previously stated these facts, and now asserts that his indirect method possesses two great advantages over the direct one proposed by Le Chatelier, namely, that a lower temperature is required, and a consequent saving of fuel and wear of retorts effected, and that pure carbon dioxide is obtained as a very valuable by-product. The very fact, however, that there are so many possible modes of treating calcium plumbate, goes far to indicate that there is at least some ground for the proposal to employ it as a substitute for barium peroxide.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Polychæte *Eunice Harassii*, the Decapod *Pirimela denticulata*, and the Opisthobranchs *Hermæa bifida*, *Embletonia pulchra*, *Antiopa hyalina*, and *Thecacera pennigera*. The floating fauna retains its recent character, *Muggiæa atlantica*, *Evadne Nordmanni* and Ophiuroid *Plutei* having been especially plentiful. The larvæ of *Polygordius*, *Magelona*, *Nerine*, *Phoronis* and of several Crustacea Decapoda have been taken; and Müller's Polyclad larvæ have made their first appearance, although as yet only in small numbers. *Pilidium* has been scarce, but other Nemertine larvæ fairly numerous. *Doliolum Tritonis*, first recorded a fortnight since, has been represented by several specimens in almost every haul of the tow-nets. The following animals are now breeding:—The Polyclads *Eurylepta cornuta* and *Stylostomum variabile*, the Polychæte *Ophryotrocha* (in the aquarium), and the parasitic Isopod *Pleurocrypta Galatheæ*. The Gymnoblastic Hydroids *Perigonimus repens* and *Podocoryne carnea* are giving off medusæ.

THE additions to the Zoological Society's Gardens during the past week include a Malayan Bear (*Ursus malayanus*, ♀) from Malacca, presented by Mr. E. Sydney Wooduviss; a Feldegg's Falcon (*Falco feldeggi*) from Morocco, and two White-shafted Francolins (*Francolinus leucoscepus*, ♀ ♀) from North-east Africa, presented by Lord Lilford, F.Z.S.; two Common Buzzards (*Buteo vulgaris*) from Europe, presented by Mrs. Henry Goodbun; a Ring Ouzel (*Turdus torquatus*, ♂) from British Isles, presented by Mr. Samuel Radcliffe; two Sulphury Tyrants (*Pitangus sulphuratus*) from South America; a Chukar Partridge (*Caccabis chukar*) from North-west India, and a Bamboo Partridge (*Bambusicola thoracica*) from North China, presented by Mr. H. H. Sharland; a Land Rail (*Crex pratensis*) from British Isles, presented by Mr. W. Stanley; an Arabian Baboon (*Cynocephalus hamadryas*, ♀) from Arabia, and a Hairy Tapir (*Tapirus roulini*) from Columbia, deposited; two Sun Bitterns (*Europyga helias*, ♂ ♀) from South America, four Patagonian Cavies (*Dolichotis patachonica*, ♂ ♂ ♀ ♀) bred in France; an Elliot's Pheasant (*Phasianus ellioti*, ♂) from China, three Chilian Teal (*Querquedula creccoides*) from Antarctic America, and two Viscachas (*Lagostomus trichodactylus*, ♂ ♀) from Buenos Ayres, purchased.

OUR ASTRONOMICAL COLUMN.

THE TRANSIT OF VENUS OF 1874.—The reports and drawings of the New South Wales observers of this transit have already been published by the Royal Astronomical Society, so that the volume which we have received, containing the observations, published by authority of her Majesty's Government in New South Wales, cannot be looked upon as containing much that is new. Mr. Russell, the Government astronomer, under whose direction this work has been compiled, seems to have taken great pains in bringing it out, for besides a long introduction summing up the results, and separate accounts of each of the reports, the book is illustrated with several photographs and drawings, a frontispiece containing photographs of the observers, and is bound in a very elaborate cover. The value of this publication lies in the fact that each observer's record is published in full, and is accompanied by numerous printed diagrams, which help to make more clear the various descriptions of phenomena that were noticed. Passing over the observations of contacts, we may refer to some of the physical phenomena which seemed to have claimed attention. With regard, first, to the black drop, it seems that only those who were using telescopes of small aperture, $1\frac{1}{2}$ to 2 inch, and low power eyepieces, saw it, while on the photographs not the slightest trace of it could be seen. The evidence, as far as the New South Wales observations go, shows, as Mr. Russell states, that "the black drop does not seem to be due to the atmospheric conditions, but rather to the imperfections of telescopes of small apertures and low power." The curious "faint tremulous shaking," as noticed at the times of the planet's ingress and egress, are put down to the temporary unsteadiness in the atmosphere. Three important phenomena which seem to have been generally observed were the rings of light and the halo seen surrounding the planet, and the ring of light round that part of the planet projected on the sky. Mr. Russell is of opinion that the atmosphere of Venus probably does not extend far enough to produce the observed phenomena of the halo, but, perhaps, a part of it could be attributed to the haze in the atmosphere caused by the forming of moisture at that time. The bright ring, described as very brilliant, was found to affect the chemicals more than the sun itself, as shown on the photographic plates; its brilliancy accounts for it being only seen on the limb not projected on the sun, and it is suggested that perhaps under favourable conditions this halo might be seen when the planet is lost in the sunlight.

THE PLANET VENUS.—Some time ago we noticed in these columns a short monograph on the "Planet Jupiter and his

Satellites," by Ellen M. Clerke. We have now before us a second one, entitled "The Planet Venus," in which the authoress lays before us in a pleasant manner a similar summary of the more important points connected with this planet's appearance. Commencing with a few words with regard to the position of Venus with relation to the other planets in the solar system, one is introduced successively to her changes of aspect due to her varying positions in her orbit, to the "silver crown" or halo produced by the refraction of the sun's rays round her globe, and to her rotation, general appearance, and polar caps. Her appearance at times of transit, and the phantom satellite, are then dealt with, the concluding chapter speaking of her in connection with the Star of Bethlehem. In this last reference is made to the "enhanced splendour with which she occasionally—once or twice in a century or so—shines at such times." That the planet does assume this increase of brightness, in addition to that due to her position, seems very doubtful, and the explanation here given to account for it depends on the luminous clouds theory suggested by the lectures on the liquefaction of gases by Prof. Dewar. The monograph is well worth a perusal, and should be widely read.

"MEMOIRE DELLA SOCIETA," &c.—Among the contributions to these memoirs for the month of July will be found a detailed account of the late eclipse of the sun as observed from the Royal Observatory of Catania; a note by Millosevich giving some data with a map for the eclipses of May 28, 1900, and August 30, 1905; and the spectroscopic observations given in graphical form of the sun's limb, made at Palermo and Rome during the months of October, November, and December of 1891.

GEOGRAPHICAL NOTES.

IN the September number of the *Geographical Journal*, Mr. Fred. Jeppe has a paper dealing in great detail with the Zoutpansberg gold-fields in the north of the Transvaal, illustrated by a new map of the district on a large scale, and by several photographs of characteristic scenery. The paper is historical as well as topographical, and contains an interesting account of the ancient workings in the Palabora region. The difficulty of orthography of place-names is referred to, several examples of alternative spelling being given, of which the series Li-Thaba, Lehlaba, Lechlaba, Lethaba, Letaba, Taba is characteristic. The district appears capable of great development when difficulties of transport are overcome by a branch from the Delagoa Bay railway.

DR. R. HANSEN contributes a paper to the last number of *Petermann's Mitteilungen* on the changes in the coastline of south-western Schleswig, with maps showing the coast as it existed in 1240, 1634, and 1892. These maps present a striking picture of the progressive diminution in area of the islands north of the mouth of the river Eider, especially Nordstrand, while those immediately adjoining the river mouth have been united with the mainland, and extended in area by the erection of dykes. As the islands have been inhabited from very early times, and protected to a certain extent by dykes, the process of coast-erosion has not been as continuous and gentle as would naturally be the case, but it has been a succession of artificial catyclasms—if the phrase may be used—brought about by exceptional storms destroying the sea-walls. In the old time each of these catastrophes was recorded amongst the islanders by the name of the patron saint of the day when it occurred.

Petermann's Mitteilungen also publishes a new map of Chitral and the surrounding districts of the Hindukush, by Mr. F. Immanuel, who describes the region in a short article.

MR. H. M. DICKSON spent the month of August on board H.M.S. *Jackal*, on behalf of the Fishery Board for Scotland, in carrying out a series of physical observations on the water between the Orkney, Shetland, and Faeroe Islands. This work was, to a certain extent, in concert with that being done by the Danish and Swedish Governments on the entrance to the Baltic and the neighbouring ports of the North Sea.

MEETING OF THE FRENCH ASSOCIATION.

THE twenty-second meeting of the Association Française pour l'Avancement des Sciences was held this year at Besançon (Department du Doubs.), capital of the old province of Franche Comté. Few towns in France, even although small, are wanting in historic or antiquarian attractions, and in these respects Besançon has much to interest the antiquarian as well as the man of science, and therefore on its own merit is well worthy of a visit. The meeting of the French Association in this town not only enabled many to see it who otherwise would perhaps never have had occasion to do so, but owing to the facilities afforded, both by the municipality and by the civil and military authorities, practically everything interesting in the town and in the environs was liberally put within the reach of the members of the Association.

The meetings of the Association were held in the Lycée, which was built by the Jesuits about the commencement of the seventeenth century, and by reason of the great number of classrooms afforded the necessary facilities for the meetings of the different sections for correspondence, &c.

The Association, although modelled on the lines of the British Association, has a slightly different scope, owing to the conditions which brought it into existence. It really commenced as the "Association Scientifique de France" in 1864, when it was founded by Le Verrier, but this subsequently to 1871 became combined with the Association Française pour l'Avancement des Sciences, the object of which was not only scientific after the mode of the British Association, but also aimed at reviving the study of science and of stimulating scientific research in the departments by bringing French scientific men together in the different principal towns throughout the country, enabling them thus to become better and more practically acquainted with France as a whole, and with the wishes, wants, and requirements of the populations. This patriotic object has been well kept in view, and the cordiality of the reception afforded to the Association wherever it goes shows how well its work is appreciated by the country. It would therefore follow that the study of the district visited forms an important part of the work of the Association, and that the "Excursions" are just as much sought after as in the meetings of the British Association.

The business usually commences with a general meeting, held either in the theatre of the town visited or other public building capable of affording the necessary facilities; in this case it was held in the theatre, a remarkable structure dating back to 1778, and inaugurated in 1784 by the Prince de Condé and his son, the Duc de Bourbon. On the stage facing the house was the table, at which sat the principal authorities of the town, civil and military, the president and principal officers of the Association, and ranged behind them the invited guests, notabilities, and chairmen of sections or committees, &c., evening dress being practically *de rigueur*. The business commenced by the Maire of Besançon reading an address of welcome to the Association, and of hearty sympathy with its objects. Then the president for the year, Dr. Bouchard, Membre de l'Institut and de l'Académie de Médicine, Professeur à la Faculté de Médicine de Paris, read his address, of which the following may be taken as the leading points. Having thanked the town of Pau for the reception given to the Association in 1892, and thanked the Maire of Besançon for the cordiality of his welcome, he defined the double object sought by the French Association's scientific progress, having for ulterior aim the greatness of their country. He paid a well-merited compliment to Besançon for its traditional love of learning and spirit of culture manifested in its celebrated men and scientific institutions. Turning then to the subject proper of his address, he expressed the desire to speak of the scientific movement and the position of scientific men at the present period, and in order to speak with competence he proposed to take his examples from the profession "which he cultivates, teaches, and practises," being justified in doing so by the fact of his having been called on to preside in his quality of a doctor. He then pointed to the wonderful development of scientific study at present, and stated that in the Faculty of Medicine of Paris 1200 students present themselves each year for the degree of M.D. (Doctorat en Médicine); of these 700 soon give up, while 500 persevere and attain their degree.

He pointed out that, whatever the causes, it is manifest that during the past fifteen years the number of students has been on the increase. He then entered on an analysis of the causes of this movement which extend to other branches of science.

"It has been said that the German schoolmaster was the conqueror at Sadowa; it was repeated after more recent disasters. It is false," but the "*mot fit fortune chez nous*," and the

whole of France resolved to accept sacrifices equal in extent to those entailed by the defeat, in order to insure a national recovery. This sentiment dominated at the foundation of the French Association. Schools in every grade have been multiplied, as also new chairs. Their faculties have been created, at least for medicine, but have not given results expected of them. The real object sought was to retain in a certain number of university centres the crowd of students which encumber the Faculty of Medicine of Paris without profit for themselves or for it. "This encumberment seems not to have diminished at Paris, and our provincial faculties might without harm see their scholastic population trebled." As a matter of fact, the newly created chairs, laboratories, and faculties have in a remarkable manner multiplied sources of employment and created outlets for young men. It is certain that many have commenced working in order to make themselves positions in the teaching world. They have subsequently seriously taken up scientific study and disinterested scientific work. "Young men of science desire, and naturally so, that their work should be immediately remunerated. This is a novelty in our old university." These pretensions are to some extent legitimate, and the budget must provide for them, but the budget is beginning to resist, and the day is approaching when the State will only ask for, and will only accept, the absolutely necessary services, while on the other hand insuring to those who devote themselves to scientific instruction a honourable position and a satisfactory future.

"The public powers must become persuaded that instruction in every degree and in every direction of employment is and must be treated as a career."

As may be seen, we have reached a critical period when the plethora is become excessive, and a situation which has become painful has to be remedied somehow. "The raising of the standard of the position of men of science is one of the spontaneous consequences of progress, at once natural and necessary."

The applications of science carry with them certain advantages; one of these well calculated to entice generous natures, is the degree of esteem accorded to a profession. Certain professions enjoy more favour in given periods than others—military men during the First Empire, lawyers under the Restoration, engineers towards 1848, and under the Second Empire during the period of railway building. The turn of the doctor has perhaps come. "I am inclined to think so when I consider the extraordinary number of doctors who sit in the elected consultative bodies, and the important *rôles* that they play therein. Dr. Bouchard then cited their influence on Parliamentary legislation in the matters of vaccination, the use of antiseptics, and sanitation. In no way does the parallel progress of scientific dignity and public esteem manifest itself more strongly than in the matter of specialties. Knowledge is no longer encyclopædic. A doctor can no longer become learned but on condition of becoming a specialist. Surgeons have been the first specialists. They have extended to so many objects their fecund activity, and enlarged their domain to such an extent, that surgery, having absorbed everything about it, will soon cease to have a separate existence. It dismembers itself into specialties which multiply day by day. "I see approaching the day when there will be no longer either doctors or surgeons, and when there will exist for those who dedicate themselves to the art of healing a general pathology with general therapeutics, including amongst other things the laws and processes of operative intervention." Starting from this general fund of knowledge, doctors will classify themselves according to the natural groups of maladies to the study and treatment of which they may dedicate themselves. "It will be necessary that the State and the teaching bodies should comprehend, foresee, and provide for this evolution which is certain to be accomplished. It is necessary, above all, that those who dedicate themselves to the medical profession should receive a common and general solid instruction which will enable each one to work out later on, with fruit, his specialisation."

He then cited the position which oculists have attained in the public esteem. They have constituted a science. The art of the oculist has become ophthalmology, "the most brilliant, sure, and, I was about to say, most perfect branch of medicine." He considers in the same way the position attained by the dentist. In changing their titles oculists and dentists wish to mark the arrival of a new age, the accession of their arts to the real scientific period.

After a few words upon the position of men of science, Dr. Bouchard stated, as showing the wide field still open for modest efforts, that of the 36,000 communes of France 29,000 have no doctor. It is a field opened up for active and devoted work.

But neither ambition nor the satisfaction of worldly requirements, nor even the thirst for self-sacrifice suffice to explain the intensity of the movement which carries along to scientific occupations so many men belonging to the intellectual and moral *élite* of the nation. People go towards science because of its attractions and fascinations. If geometry can excite a very passion, why not the study of physical phenomena, the determination of biological laws? "Medicine has seductions which may raise a smile, but which all those who have dedicated their existence to it understand." To grasp the causes of disease, discern their modes of action, is the question which has been posed since the origin of medicine; it is the problem which for the last 2000 years and more has tormented the greatest intellects of the medical profession. These causes have been revealed to us for a great number of maladies by a man who was not a doctor. This revelation dates from but yesterday, and it is only since yesterday that we have been able to introduce into experimentation this factor up to the present unknown—the morbific cause (*la cause morbifique*). From this day dates the great reform in medicine. The modes of work of the old school were then compared with those of the new. They did what they could, what they would always have been obliged to do. They worked out the natural history of malady. They have seen the dawn of a new day. They have become acquainted with the *rôle* of the microbe in the universal transformation of matter, whether dead or alive, organic or inorganic, an idea so great and so fecund that each science in particular owes to it a part of its progress, while to it medicine owes its very renewal. Herein we have the true reason of this allurement which carries away so many liberal minds to the study of medicine. He then pointed out the parallel development of the study of septicism, and of the intimate relations of the various organs in their functions, and finished by indicating as the principal directing ideas of contemporary medicine, infection, diathesis, auto-intoxication, useful *rôle* of the internal secretions, nervous reactions, provoking and impeding healthy actions. He finished with some remarks as to the *rôle* of the Association—one of its great objects being to produce a scientific decentralisation. This decentralisation has been attained; it is in the minds while waiting to be affirmed by our Institutions. Meanwhile we continue our yearly peregrinations. "*Nous sommes en train de découvrer la France.*"

The address was remarkably well received.

The Secretary of the Association afterwards read a report on the work done during the last season, and the Treasurer rendered an account of the financial state of the Association, showing a balance in its favour of about 800,000 francs; Dr. Bouchard then declared the twenty-second session of their congress opened.

In the evening there was a reception held by the Maire at the Hotel de Ville, which was well attended.

At five o'clock on the same evening the bureaux or staff of officers of the different sections were fixed, and the agendas for the meetings to be held next morning. There were no addresses from the presidents of the sections.

Of the seventeen sections, Nos. 1 and 2 were devoted to Mathematics and Astronomy, 3 and 4 to Civil and Military Engineering, 5 and 7 to Physics and Meteorology, 6 to Chemistry, 8 to Geology and Mineralogy, and 9 to Botany. Section 10 dealt with Zoology and Physiology, 11 with Anthropology, 12 Medical Sciences, and 13 Agriculture. Geography was considered in section 14, Political Economy in 15, Pedagogy in 16, and Hygiene in 17. To all these sections a large number of important communications were made.

EXCURSIONS.

Sunday, August 6, Salins and Source of the Lison River.—Leaving at 6.30 a.m. by special train, Salins, situated about twenty-three miles south-south-west of Besançon, was reached at 7.30 a.m., after running through a hilly country showing the limestone formation of the Jura and fully cultivated. Salins is, as the name indicates, situated in a salt district, and the salt springs have been worked from very early if not prehistoric

times. At present it is very much frequented on account of the medicinal action of the water. The situation is remarkable, being overlooked by bold heights which rise to altitudes of 620m. (Fort Belin) and 599m. (Fort St. André), the town itself being at an altitude of 354m. above the sea-level. The curative effects of the salt waters (the mother-liquors remaining after the separation of the salt) are mainly attributed to their remarkable richness in bromide of potassium 322 c. gr. per kg. of water. The natural salt springs worked contain 27 gr., 5 of chloride of sodium per kg., and yield about 13,000 h.lit. per day at 12° C.; they are also largely used for bathing purposes. The total production in salt of these works is about 6000 tons per annum.

Leaving Salins in carriages, the excursionists followed the road which winds up through the heights, and thus had an occasion of seeing the successive outcrops of the geological formations so characteristic of the district, Trias, Lias and Lower Jurassic, the roadsides affording plenty of fossils at different points. The "Col" having been reached, a high undulating district was attained showing the influence of altitude by the relative lateness of the crops, oats, &c., and their sparseness. The farmhouses also mark the vicinity of the high Jura in their form, high-pitched tiled roofs, massiveness, and overhangings, all evidencing relative comfort and prosperity. Having passed the bridge called the Pont du Diable, from the fantastic head sculptured on the keystone of the principal arch, and from the wildness of the gorge over which the road leads, the excursion reached about 11 a.m. the charming and well-wooded valley, deeply enclosed in bold and picturesque Jurassic escarpments, called Nans sous Ste. Anne. Here an excellent *déjeuner* was served under a tent, and in the afternoon a visit was made to the sources of the Lison, situated in a deep hollow, worn out in the Jurassic beds, and receiving from a certain height a cascade which disappears in one of those caves so common to all limestone formations.

The return to Salins was by a different route to that of the morning, but showing fine vistas, and displaying on all sides careful culture and abundant forest growth, which is mostly communal and worked with great care and skill. Along the road in the morning lay piles of timber showing diameters at the butts of 2 feet and 2½ feet, and lengths of 15 to 20–25 yards. Having visited the salt-works in the town, and seen the evidence of their antiquity in the succession of massive masonry constructions required from time to time for their preservation, dinner was served about seven o'clock in the hotel of the baths, and the party returned to Besançon.

Tuesday, August 8, Montbéliard and Belfort. — Leaving Besançon at 6.15 a.m., with the continued fine and warm weather of this wonderful season, the line ran along the Doubs River through a very picturesque and highly cultivated country. Montbéliard was reached about 7.50, when after a short halt the excursionists proceeded by steam tram to the works of Messrs. Peugeot Bros., at Audincourt. The visitors were divided in two series, A and B; the first were conveyed to the workshops of Valentigney (rolling mills, manufacture of springs and saws), and the workshops of Beaulieu (manufacture of bicycles); the last section, B, was conducted through the workshops of Terre Blanche (tools, hardware in general, coffee-mills, coach factory, electrical force plant, &c.). These works seem very active, well organised, and well in touch with the requirements of their markets, the tools manufactured by the firm having a high reputation for quality and cheapness. Everything indicated care and attention to the wants of the working people, and the general air of comfort and prosperity which was apparent in other parts of the department, and about Besançon, were here equally evident. Montbéliard was reached about twelve o'clock. There is little remarkable in it except a château of the fifteenth and sixteenth century, which now serves as barracks for the troops. The town is largely inhabited by a race of Protestants, descendants of the Anabaptists who sought refuge there from Friseland. There is also a Jewish element in the population, as indeed also at Besançon and Dijon, marked by the synagogue of a conventional style of architecture and the Hebrew inscriptions. Montbéliard is a very pretty busy town as regards manufactures, but the sewage arrangements *laissent à désirer;* this is to a certain degree intelligible from the fact of the town being situated on the canal which joins the Rhône and the Rhine at the junction of the rivers Allaine, Savoureuse, and Lizaine, at an altitude of 322m. As seen on the occasion of the visit, that is, during a season of great drought, there were evidently elements of typhoid fever, whether prevalent or not was not ascertained. From Montbéliard to Belfort the line ran through a more rolling country than that in the immediate neighbourhood of Besançon. Belfort (pronounced by the French "Bay-four") was reached at 2.15 (after an excellent *déjeuner* at Montbéliard, served in the gymnasium). Situated on the frontier, always a fortress of note, and now rendered celebrated by its splendid defence by Colonel Denfert during the campaign of 1870, its historic interest overpowers its other attractions. Special permission had been obtained for the excursionists to visit the château or citadel. This permission was largely taken advantage of by the excursionists, notwithstanding the somewhat abnormal heat of the afternoon sun. Guided by the officers of the Association and by those of the military service, the visitors were first conducted to the site of the splendid colossal lion which graces the western face of the fortress. Designed by Bartoldi, and executed in Vosges sandstone, it harmonises admirably with the lines of the ground and of the fortress structure. Whether the colour adopted is the best artistically is a matter for the sculptor and artists in general, but the lines are very fine, and the attitude of the lion very happy and expressive. The visitors were then conducted to the plateau, or flat roof, which crowns this part of the fortress, from which is discovered a splendid panoramic view of the surrounding country. An officer of the fort very obligingly gave a detailed description of the district surveyed, explained the position of the German army of siege, showed the line now forming the frontier, pointed out the various points of interest in view from the Ballons des Vosges in the north, to the Swiss Jura in the south, with the vast and fertile plain of Alsace lying between these points, here and there dotted with villages in the distance. One could not fail to appreciate the significance of the absence of a natural frontier line at this point, and at once to understand the vastness of the armaments which have to make good the security of a country so bounded.

A visit was then paid to the monument raised to the volunteers who fell during the campaign of 1870, and then a return was made to the principal square, in which the Town Hall is situated; here, at seven o'clock, dinner was served in a splendid hall ornamented with a set of very fine historic paintings illustrating events in the history of the place. A few and deeply felt words of welcome from the Maire, an equally short but expressive speech from the Préfect of the Department, and the dinner ended under the happiest of conditions for the visitors. A municipal band played during the dinner, and gave the members of the Association a *retraite aux flambeaux* to the station, whence Besançon was reached about 11.15 p.m.

Visit of the Citadel of Besançon, August 7.—By special permission the citadel was opened to the members of the Association in the afternoon of this day. The members, taking advantage of it, assembled at the Roman triumphal arch still preserved and known as the Porte Noire. Thence ascends the steep road conducting into the fort, and remembering that it may have been, or rather must have been, used by Cæsar when occupying and holding garrison in this city, one could not but feel a greater interest attaching to the various points presented by the guide. The structure of the fort is mainly due to Vauban, but of course is now somewhat out of date, but the position, taken in conjunction with the occupation of the neighbouring heights, is still very strong, and of great military value. From the parapet of the highest part of the fortress a splendid bird's-eye view is had of the town and its surroundings, while the windings of the River Doubs underneath, the variety of the culture clothing the neighbouring hills, the forts quietly looking out over all, and the hum of activity ascending the town, rendered the visit highly interesting, despite the abnormal heat and the climb to the lofty point of view. During the reconstruction of the fort by Vauban, he was obliged to demolish the church of Ste. Etienne, badly injured during the siege. The material was not, however, lost, and amongst other usages a tombstone, evidently of a bishop or an abbot of the Middle Ages, was used as a flooring for one of the sentry boxes or videttes which line the parapet or path running round the summit of the fortress. Other remains have been preserved, partly in the fort, and partly in the garden near the Porte Noire, the former site of a Roman theatre.

Final Excursion, August 11 to 13.—An accident, slight in itself but troublesome for the time, prevented me assisting at this excursion, which comprehended the source of the Loue Pontarlier, Neuchâtel, Bienne, Chaux de Fonds, and the Saut du Doubs, that is, an extremely dangerous and picturesque district on the frontier of Switzerland.

J. P. O'REILLY.

VARIATIONS OF LATITUDE.[1]

"ALL astronomy," says Laplace, "depends upon the invariability of the earth's axis of rotation upon the terrestrial spheroid and upon the uniformity of this rotation." He adds that "since the epoch when the application of the telescope to astronomical instruments gave the means of observing terrestrial latitudes with precision, no variations in such latitudes have been found which could not be attributed to errors of observation, which proves that since this epoch the axis of rotation has remained very near the same point on the terrestrial surface." ("Mécanique Céleste," tome v. page 22.) Admitting then the position of the earth's axis, and consequently the values of terrestrial latitudes, to be sufficiently invariable for the purposes of the astronomer, the question has been many times raised whether this conclusion represents more than a kind of first approximation to the truth.

As this subject, or something very much like it, was receiving more or less attention on the part of the ancient geographers two thousand years ago or more, we can hardly claim for it the charm of novelty. An important feature of the geography of Eratos Thenis, written between 200 and 300 B.C., was a critical review of the work of his predecessors. His map of the world, which represented the best and latest information of his day, had as a sort of base line, or axis of reference, a parallel of latitude drawn from the pillars of Hercules towards the east, passing north of the island of Sicily, across the southern part of the Peloponnesus, and eastward across the continent of Asia. The positions of many places with reference to this line differed very considerably from those assigned by his predecessors. At the time of Ptolemy—400 years later—it was known that the map of Eratos Thenis failed in many particulars to conform to the then existing order of things. The conclusion was obvious; evidently changes had taken place in the relative positions of a number of prominent places on the earth; nor were these changes simply the trifling fractions of a second with which men are struggling so valiantly in these degenerate days, but such satisfactory and tangible quantities as three, four, or five degrees. Ptolemy's geography furnished the basis for comparisons and discussions of this kind for fifteen hundred years. Some few of his latitudes, as that of Alexandria, were determined with such precision as was possible in those days, while the foundation of very many was little more than guess-work. Comparisons from time to time with later determinations brought to light discrepancies which served to keep the question open and to furnish material for speculation.

In this connection we shall stop only to mention Dominique Maria de Ferrare, who enjoys the distinction of having had as a disciple the illustrious Copernicus. This philosopher believed that the evidence showed conclusively a progressive change in the position of the pole, and that in time the torrid and frigid regions would in a manner change places.

So far as the latitudes of Ptolemy were concerned it was pointed out[2] that the discrepancies were in part due to the method employed in their determination—that of the gnomon which gave the altitude of the sun's upper limb, and consequently a value of the latitude too small by a quarter of a degree.

Two or three hundred years ago much interest was taken in this question. We find associated with it the familiar names of Tycho, Rœmer, Hevelius, Picard, Cassini, and many others. As greater accuracy in methods and instruments prevailed, it became evident that the rough positions of Ptolemy could not be employed with any confidence in discussions of this character. In connection with these more exact methods also a new phenomenon began to manifest itself, viz., changes of short period.

Christopher Rothman, a contemporary of Tycho, found systematic differences between the determinations of the latitude of his observatory made in summer and winter. Tycho's observations at Prague showed a like peculiarity. Rœmer also discovered it. He attributed it confidently to periodic changes in the position of the earth's axis, and hoped in time to give a complete theory of the same.

A memoir by J. D. Cassini,[3] published in 1693—200 years ago almost precisely—gives a very complete summary of the state of the problem at that day. After a detailed examination of the evidence he concludes:—"Notwithstanding all these apparent variations, we may say that not only has no extraordinary change in the altitude of the pole or in the meridian altitude of the sun occurred in recent times, but that the heavens have at all times occupied the same position with regard to the earth as during the past century. For there is reason to believe that all these variations which have been mentioned came from several defects which occur in observation." He then goes over in detail those sources of error which are so familiar to us—instrumental errors and defects in theory—one only having a somewhat unfamiliar appearance, viz., we may reasonably suppose that variations in the direction of the plumb line occur similar to those of the magnetic needle. Nevertheless he says it is very probable that from time to time small changes in the altitude of the pole actually do occur, but they are periodic in character and do not exceed two minutes in amount. Thus, instead of several degrees which were conceded by the astronomers of previous centuries, only a paltry two minutes was now allowed, but with improved instruments, with the discovery of aberration and nutation, and the perfection of the theory of refraction, even this modest allowance was gradually reduced to a vanishing quantity.

Meanwhile new arguments were found for a reconsideration of the question. Geology had taken its place among the sciences. In the investigation of the fossil remains of plant and animal life abundant evidence was found of a former temperate or subtropical climate within the Arctic circle. It was also evident that at one time considerable portions of Europe and North America had been covered with glacial ice. Laplace mentions the argument for a change in the position of the earth's axis, founded on the existence of the fossil remains of elephants in Northern Siberia, but believes that the discovery of the remains of one of these animals preserved in ice, the body of which was covered with thick hair, turns the argument against those who employ it (M.C. v. p. 20).

In the *Quarterly Journal of the Geological Society* for 1848 is found a communication from a mathematician and astronomer, Sir John Lubbock, on changes in climate resulting from changes in the earth's axis of rotation. He suggests a mathematical discussion of the problem in order to determine, as he says, "under what hypothesis a change of the position of the axis of rotation is possible or not." The President of the Association, Sir Henry T. de la Beche, in the annual address of 1849, deals at some length with this subject. Again, in 1876, we find Sir John Evans, then president of the Society, discussing the problem (*Quarterly Journal of the Geological Society*, 1876, p. 60). He describes with much detail the fossil remains found in Spitzenbergen and Greenland belonging to the Miocene, upper and lower Cretaceous, Jurassic, and other geological periods, all of which point to a former temperature much above the present. Thus, among the Miocene plants of Spitzenbergen Prof. Nordenshiäld mentions the swamp cypress, now found in Texas, siquoias of great size, limes, oaks, and even magnolias. So in the Lower Cretaceous period Prof. O. Heer distinguished seventy-five species, including ferns, Cycadeæ and Coniferæ, many of which are closely allied to species now found in sub-tropical regions. From these remains Prof. Heer infers that the climate of Greenland and Spitzenbergen during the Cretaceous period was very much the same as that which now prevails in Egypt and the Canary Isles. The existence of beds of coal, of mountain limestone formed of the remains of corals and bryozoa, and shells of marine molluscs, the remains of Ammonites, Nautili, and even a Saurian—the *Ichthyosaurus polaris*—all point in the same direction. While, as Prof. Houghton remarks, the arguments from the presence of Ammonites and Coalplants strengthen each other, the one demanding heat, the other light.

Sir John Evans sums up the arguments as follows:—"The three points which it appears to me are most important to bear in mind with regard to the article of flora are (1) that for vegetation such as has been described there must, according to all analogy, have been a greater aggregate amount of summer heat supplied than is now due to such high latitudes. (2) That there must have been a far less degree of winter cold than is in any way compatible with the position on the globe; and (3) that in all probability the amount and distribution of light which at present prevail within the Arctic circle are not such as would suffice for the life of the trees."

He afterwards supposes a hypothetical case of possible

[1] Address before Section A (Astronomy) of the American Association for the Advancement of Science, at Madison, Wisconsin, by Prof. C. L. Doolittle, of South Bethlehem, Pa., President of the Section.

[2] Delambre, "Histoire de l'Astronomie au Dix-huitième Siècle," p. 155.

[3] S'il est arrivé du changement dans Lautein du pole au dans la Cones du Soleil? (*Memoires de l'Academie*, tome x. p. 360.)

elevation and depression, to which he invites the attention of mathematicians to determine whether it would not produce a change of 15″ or 20° in the position of the pole.

The invitation was duly accepted by Sir Wm. Thompson—now Lord Kelvin—and by Prof. G. H. Darwin. The former, by a process which he does not explain, convinced himself that a *vera causa* existed in the distortion of the earth, as shown by geological and other evidence, sufficient to produce large deviations in the position of the axis. To quote his own eloquent words, "Consider the great facts of the Himalayas and Andes, and Africa, and the depths of the Atlantic, and America, and the depths of the Pacific and Australia; and consider further the ellipticity of the equatorial section of the sea-level, estimated by Capt. Clarke at about one-tenth of the mean ellipticity of meridianal sections of the sea-level. We need no brush from the camel's tail to account for a change in the earth's axis; we need no violent convulsions, producing a sudden distortion on a great scale, with change of axis of maximum moment of inertia, followed by gigantic deluges; and we may not merely admit, but assert as highly probable, that the axis of maximum inertia and the axis of rotation, always very near one another, may have been in ancient times very far from the present geographical position, and may have gradually shifted through 10, 20, 30, or 40 or more degrees, without at any time any perceptible sudden disturbance of either land or water." (British Association Reports, 1876, Sections, p. 11).

Prof. G. H. Darwin has made this the subject of an elaborate mathematical investigation (*Phil. Trans.* 1877, p. 271). As the basis he takes the earth as we find it, assuming that the elevations of the continents and depressions of the ocean represent the kind and amount of distortion to which the earth has been subjected in the course of its past history. The mean elevation of the continents being about 1100 feet, and the mean depth of the oceans about 15,000 feet, it follows that in order to convert an ocean bed into a continent, or *vice versa*, an elevation or subsidence of 16,000 feet must have taken place. This would not, however, correctly represent the distortion of the earth, for the waters of the ocean flowing into the depressions would considerably modify the result. Taking into account the density of water as compared with the surface rocks, it appears that an extreme elevation of 16,000 feet from the bottom of the ocean to the surface of the supposed continent would be equivalent to an effective elevation of about 10,000 feet on a sealess globe. In case of a perfectly rigid globe, the only deformation which could take place would be that due to a redistribution of the surface materials. For a given elevation with a corresponding depression the maximum effect upon the position of the earth's axis would be produced when the elevations occurred in latitude 45° in two diametrically opposite quarters of the earth with corresponding depressions in the remaining quarters. In such a globe Prof. Darwin's analysis showed that the pole could never have wandered more than 3° from its original position as a consequence of the continents and oceans changing places. If, however, the earth is sufficiently plastic to admit of readjustment to new forms of equilibrium by earthquakes or otherwise, possible changes of 10° or 15° may have occurred.

This would, however, require such a complete changing about of the continents and oceans, with maximum elevations and depressions in precisely the most favourable places, as has certainly never occurred within geologic time. In fact, the evidence indicates that the continental areas have always occupied about the same position as now.*

It would appear, therefore, that the geologist must give up this hypothesis of great changes in latitudes as a factor in the earth's development, unless, indeed, some other cause can be found of sufficient potency to produce the desired result. Such an agency is, perhaps, alluded to by Prof. Arthur Schuster in his address before Section A of the British Association a year ago (NATURE, 1892, Aug. 4, p. 327). He propounds this question: "Is there sufficient matter in interplanetary space to make it a conductor of electricity?" He adds that he believes the evidence to be in favour of this view; but the conductivity can only be small, for otherwise the earth would gradually set itself to revolve about its magnetic poles. If such an action were admitted, we must suppose the poles of revolution and magnetic poles would long since have been brought into practical coincidence, unless this consummation were frustrated by changes in the position of the latter.

However all this may be, the question before the practical astronomer is this—Have we any reliable evidence showing that progressive changes in the position of the pole are now taking place? If this question were submitted to a jury composed of twelve good men and true from the astronomical profession, the chances would be largely in favour of a verdict in agreement with Laplace's decision seventy years ago.

At the International Geodetic Conference held in Rome ten years ago, Mr. Fergola brought forward a plan looking to a systematic study of this and other questions connected with changes of terrestrial latitudes. This plan, which was favourably received, consisted in a scheme for simultaneous series of observations at pairs of observatories on nearly the same parallel of latitude, but differing widely in longitude. The instruments were to be prime vertical transits, and the same stars to be employed at each of the two stations. Several pairs of observatories were designated by Fergola as being favourably situated for the purpose. Among others, Washington and Lisbon, the difference of latitude being 11′ 7″, that of longitude 4h. 31m. It is understood that efforts in this direction were made at Washington, but the necessary cooperation at the other end of the line was not secured, and the plan came to naught. It has not come to my knowledge that the scheme was at that time seriously considered at any of the other points selected.

Fergola gave a tabular statement which at that time seemed to show small but progressive diminutions of latitudes in Europe and North America. This table, with some additions—the latter enclosed in brackets—is as follows:—

		°	′	″
Washington ...	1845	38	53	39·25
	1863			38·78
	[1883			38·94]
Paris	1825	48	50	13·0
	1853			11·2
	[1891			10·95]
Milan	1811	45	27	60·7
	1871			59·19
Rome	1810	41	53	54·26
	1866			54·09
Naples	1820	40	51	46·63
	1871			45·41
Königsberg ...	1820	54	42	50·71
	1843			50·56
Greenwich ...	1838	51	28	38·43
	1845			38·17
	1856			37·92

In all these cases there is an apparent diminution during the present century. A similar tendency is shown by the observations of Peters, Gyldèn, and Nyrèn at Pulkowa, also by my own observations at Bethlehem since 1875. Instances are not wanting, however, where this diminution fails to manifest itself. Possibly most of the discrepancies shown here may be referred to periodic changes, the existence of which is no longer in doubt. It is by no means impossible or improbable that small local changes of latitude may occur due to slipping of the superficial strata of the earth's crust. That such lateral movements have taken place in times past in connection with mountain upheavals is, without doubt, true. That they are still going on in certain localities is probable; whether they are of sufficient magnitude to admit of measurement can only be determined by observation.

When we remember how few points there are on the surface of the earth, whose latitude was determined even no longer ago than fifty years, within one or two seconds of the truth, probably we should suspend judgment for the present with reference to the whole subject of progressive changes.

We come now to a phase of our subject with reference to which we can speak with some confidence, viz. periodic changes.

That in the case of a perfectly rigid earth, theory points to the existence of such a periodic change, completing its cycle in about ten months, has been long understood. In connection with the general problem of the motion of a free body under the action of any system of forces, the consideration of which

was suggested by the problems of the solar system, we find the names of the leading mathematicians of the last century, d'Alembert, Segner, and Euler, not to mention others. It was the latter who, in 1765, in a work entitled "Theory of the Motion of Solid and Rigid Bodies," gave the equations the final form which Laplace declares seem to him the most simple which can possibly be obtained. (M. C.V. p. 284.)

The elegant form of these equations was due to the employment of the principle discovered by Segner, viz. that at every point of a body there are at least three principal axes of inertia at right angles to each other, which possess some very important properties. One of these properties is this—that if the body be set revolving about one of these axes which passes through its centre of inertia, and is understood by outside forces, it will continue to revolve about this axis for ever. If, however, it be started in its revolution about some other axis, the condition of things will be different.

In the first approximation to the solution of Euler's equations when applied to the earth, we meet with two constants of integration, whose values depend upon the position of the axis of revolution with respect to the principal axis of inertia (from which it can never differ greatly) at the instant which we take as the starting point of our integration. We further find that the presence of these quantities in our equations shows a revolution of the instantaneous axis of rotation about the principal axis of inertia. This rotation is in the same direction as the diurnal motion, the angular velocity y being expressed by the formula

$$y = \frac{C - A}{A} u$$

Where u is the velocity of diurnal rotation, C and A are the principal moments of inertia of the earth, the first with respect to the polar axis, the second with respect to an equatorial axis, the figure being regarded as that of an ellipsoid of revolution. The ratio

$$\frac{C - A}{A}$$

is found from the value of the constant of nutation, the degree of accuracy being such that the theoretical period of this rotation is known probably within one or two days. The value given by Oppolzer is 304·8 mean solar days. We shall assume it to be 305 days.

The angular distance between the two axes, evidently very small in case of the earth, can only be determined by observation, and will manifest its existence by fluctuations in the latitude having a period of 305 days. The first attempt to find by observation whether or not this movement was appreciable was by Bessel. This method was not well adapted to the purpose, and the result was negative or inconclusive.

The first quantitative determination which seemed worthy of confidence was made by Dr. C. A. F. Peters, of Pulkowa ("Recherches sur la Parallax des Etoiles Fixes," p. 146), in 1842. From a careful series of meridian circle observations carried on for thirteen months he found for the angle between the two axes ·071″ ± 017. Nyrèn followed with a careful discussion of the value given by the observations of Peters, Gyldèn, and himself with the same instrument. The results were, ·101″, ·125″, and ·058″. Downing found from the Greenwich observations from 1868–77 ·075″ (*Monthly Notices, R.A.S.*, March, 1892), while Newcomb found the somewhat smaller value ·04″ from the Washington prime vertical work.

These results are in reasonably good accord, and at first sight seem to show conclusively a real separation of the two axes, but as pointed out by Hall ("American Journal of Science," March, 1885, p 223), the form of the expressions for determining the quantity is such that an apparently real value will always be obtained. If we assume a uniform rotation of one pole about the other our equations will contain two unknown quantities, x and y, where $x = \rho \cos \xi \cdot y = \rho \sin \xi$, therefore whatever values we may find for x and y. ρ will always have a real and positive value. This may, therefore, be nothing more than a function of the errors of observation. The true test was therefore to be sought in the agreement of the values of ξ when reduced to a common epoch. These were found to be quite discordant, so much so as to throw doubt upon the reality of the results. The truth, as we now understand it, being that Euler's theory, perfect as it is, does not apply without modification to the present problem—the earth not being strictly a rigid body. Doubts as to the absolute rigidity of the earth had been expressed by more than one investigator, and the matter was discussed in 1876 by Lord Kelvin (British Association Reports, 1876, Sections, p. 11), and in 1879 by Prof. George Darwin (*Phil. Trans.* 1879), in relation to the problems of precession, nutation and tidal action—the conclusion being that the rigidity of the earth is probably between that of steel and glass. The bearing of this upon the present investigation was first pointed out by Newcomb *Monthly Notices Royal Astronomical Soc.*, March, 1892), viz. that in consequence of the elastic yielding of the earth as a whole the period of this rotation would be lengthened.

Before considering this matter in detail, however, the exigencies of historical continuity require us to glance at some remarkable results of observation.

In the spring of 1884 Dr. F. Küstner, of Berlin, began a series of observations, the results of which were destined to awaken a widespread interest in this subject, or, perhaps more properly, to crystallise the interest which already existed. His original purpose was sufficiently modest. The great meridian circle of the observatory requiring some repairs, he proposed to employ the interval while it was out of service in making a limited series of observations with another instrument, the universal transit, according to the Horrebow-Talcott method for the investigation of the constant of aberration. His purpose was not so much that of deriving a new and definitive value of this constant, which should be entitled to rank with the excellent results previously obtained, as to test practically the applicability of the method to this purpose, and to acquire the experience which at a future time might lead to a favourable result in a more complete series. Possibly it would be overstraining a time-worn simile to compare the modest investigator with Saul, son of Kish, who, going forth to seek his father's asses, found a kingdom; but certain it is that his results were vastly more important and far-reaching than anything which he could have anticipated in his original programme. His observations, not numerous, but of the first order of excellence, led to a value of the constant of aberration which appeared to be wholly inadmissible. Many an investigator would have been discouraged with this apparent failure, and the world would have known nothing of it. Not so with Küstner. Instead of abandoning the experiment as a failure he set himself resolutely to work to discover the cause of the anomaly. After examining the various causes which might be supposed to have contributed to such a result, personal, instrumental, and refractional, he announced without hesitation that it was due to a change in the latitude itself, viz., that from August to November, 1884, the latitude of Berlin had been from 0.2″ to 0.3″ greater than from March to May in 1884 and 1885. This conclusion was materially strengthened by the examination of a considerable amount of collateral evidence, particularly Nyrèn's elaborate series of observations at Pulkowa from 1879 to 1882, employed by the latter in discussing the constant of aberration. This somewhat bold hypothesis naturally provoked much discussion, and many were sceptical as to its truth; but instead of resorting to polemics, and quoting the authority of Aristotle and the sacred Scriptures on the one side or on the other, means were promptly found for testing it. These comprised both a re-examination of old observations and new ones, undertaken for this express purpose. Among the latter were special series of latitude determinations extending over an entire year or more at Berlin, Potsdam, Prague, and Bethlehem, all by Talcott's method. All of these agreed most satisfactorily in showing the reality of the fluctuation during the years 1888, 1889 and 1890. But the final test which should determine whether the changes observed were due to movements of the earth's axis required observations to be carried on simultaneously at points differing widely in longitude. A latitude campaign instituted for this purpose was therefore entered upon in the summer of 1891, under the auspices of the International Geodetic Association, operations being carried on at Berlin, Prague, Strassburg, Rockside, San Francisco, and Waikiki.

Some of the results have been in possession of the public for several months, and they show in the most conclusive manner that we are dealing with a movement of the earth's axis.

A series of latitude observations was also carried on at Paris from December, 1890, to August, 1891; part of the time two different observers were employed using different instruments, their results agreeing almost exactly. (*Comptes Rendus*, 1892,

p. 895.) Science acknowledges no national allegiance, but it is interesting to note that this series fails to show any trace of the periodic change; considering the smallness of the quantity in question and the limited scope of the series this failure proves nothing *pro* or *con*. Yet Admiral Mauchez expressed the opinion that the fluctuations which the Germans had been attributing to changes of latitude were due to some other cause (*Comptes Rendus*, 1892, p. 862.) It is also noteworthy that the value of the latitude found at this time is 0·8″ smaller than given by the elaborate investigation of M. Galliot in 1879, in which he employed 1077 observations by ten different observers. (*Comptes Rendus*, vol. lxxxvii. p. 684.) In this discussion an annual period, having a semi-amplitude of 0·20″ manifested itself somewhat obscurely; but M. Galliot placed on record his opinion that this had its origin in some cause other than a change in the latitude.

We have seen how it came about that the reality of periodic fluctuations in the earth's axis was placed beyond dispute. As to the true nature and law of these fluctuations we should probably now be groping in darkness but for the services which Dr. S. C. Chandler has rendered in the way of solving the mystery. Before Dr. Chandler attacked the problem no one appears to have called in question the applicability of Euler's theory to the case of the earth. The impression was indeed quite general that the changes were for the most part of a fortuitous character, produced by precipitation of rain and snow, by ocean currents and aerial currents acting unequally in different hemispheres, and therefore in so far as they might manifest a periodicity, this would be annual in its character. As early as 1876 Lord Kelvin expressed the opinion that the causes were sometimes sufficient to produce change of half a second in the course of a year. (British Association Reports, 1876, Sections p. 11.) It seemed therefore beyond question that any periodic change must conform to the 305 day period of Euler, or to an annual period, or a combination of the two. The latter hypothesis was worked out very completely by Messrs. R. Radeau (*Comptes Rendus*, vol. iii. p. 568) and F. R. Helmert (*Astronomische Nachrichten*, vol. cxxvi. p. 217).

Matters were in this condition when in 1891 Chandler attacked the problem. The main features of this investigation are given in a series of seven remarkable papers published in the *Astronomical Journal*, written from time to time while the work was still in progress, and when, as a matter of course, the final result could not be known. Like Kepler, the author carries us with him along the successive stage of the investigation, we share with him his triumphs and disappointments, and rejoice with him when well-merited success crowns his efforts. As to his methods and purpose, these are given in his own words. "I deliberately put aside all teachings of theory, because it seemed to me high time that the facts should be examined by a purely inductive process that the nugatory results of all attempts to detect the existence of Eulerian period probably arose from a defect of the theory itself; and that the entangled condition of the whole subject required that it should be examined afresh by processes unfettered by any preconceived notions whatever. . . . The problem which I therefore proposed to myself was to see whether it would not be possible to lay the numerous ghosts in the shape of various discordant residual phenomena pertaining to determinations of aberration, parallaxes, latitudes, and the like, which had heretofore flitted elusively about the astronomy of precision during the century; or to reduce them to some tangible form by some simple consistent hypothesis. . . . It was thought if this could be done, a study of the nature of the forces as thus indicated by which the earth's rotatiion is influenced might lead to a physical explanation of them."

From May 29, 1884, to June 25, 1885, almost exactly the time covered by the observations of Küstner, at Berlin, Chandler was observing at Cambridge with the Almucantar. The resulting values of the latitude shared a progressive change, for which there seemed no explanation unless the change were that of the latitude itself. At that time this seemed too radical an hypothesis, so the results were printed as they appeared, leaving the explanation to the future. The close agreement of Küstner's results, the verification by the subsequent work at Berlin, Pulkowa, Potsdam, and Prague seemed to warrant the expenditure of the labour involved in a thorough investigation of the entire subject. He began with Küstner's work at Berlin, the vertical circle observations of Gyldèn and Nyrèn at Pulkowa, and the precise vertical observations of α Lyrae at Washington 1862–66. These agreed in showing a period of 427 days. The examination of observations of circumpolar stars at Melbourne, and of Polaris at Leyden, partially confirmed the result.

Next came the observations of Bradley at Kew, Wanstead, and Greenwich. Here a very puzzling phenomenon appeared, the period being only about one year, with an amplitude of nearly an entire second. In discussing the observations of Brindley at Dublin, made during the early part of the present century, an opportunity occurred to wrestle, and that successfully, with one of the ghosts before referred to, viz., the singular results which Brindley had obtained for the parallaxes of a number of stars, and which led to an interesting discussion between Pond and himself.

Thus series after series was analysed with results in the main encouraging, frequently puzzling, and sometimes disappointing. The law, if such existed, did not appear on the surface. The secret could only be discovered by an elaborate analysis of the material. Accordingly, forty-five different series, extending from 1837 to 1891, comprising more than 33,000 observations, were examined, from which an empirical law was deduced as follows.

The velocity of rotation of the pole was a maximum about 1774, the period being about 348 days. Since then the velocity has diminished at an accelerated rate, the period in 1890 being 443 days.

During the last half century the semi-amplitude has remained sensibly constant at 0·22″.

Only three of the forty-five series examined, and these among the least precise, intrinsically gave results contradictory of the general law. The next step in the process was to analyse the observations in a different manner, to discover whether the deviations from the provisional law were real, also in what manner the variations of the period were brought about. For this purpose the results were tabulated chronologically at twenty-day intervals, all reduced to the meridian of Greenwich. As a result the real nature of the phenomenon was most distinctly revealed, and was as follows.

The observed value of the latitude is the resultant curve arising from two periodic fluctuations superposed upon each other. The first of these, and in general the more considerable, has a period of about 427 days, and a semi-amplitude of about 0·12″. The second has an annual period with a range variable between ·04″ and ·20″ during the last half-century. The maximum and minimum of this annual component of the variation occur at the meridian of Greenwich about ten days before the vernal and autumnal equinoxes respectively, and it becomes zero just before the solstices.

As the resultant of these two motions, the variations of the latitude is subject to systematic alterations in a cycle of seven years' duration, resulting from the commensurability of the two terms. According as they conspire or interfere, the total range varies between two-thirds of a second at a maximum to but a few hundredths of a second at a minimum.

Accompanying the paper is a diagram showing the relation between this theory and the observations of the fifty-four years on which it is based. The agreement, at times almost perfect, at other times shows deviations, apparently systematic, which are perhaps due to imperfect knowledge of the constants, or to erratic deviations of meteorological origin.

Dr. Chandler finds the general outcome full of promise for the astronomy of precision, showing that observations are free from defects of a systematic character to a much greater extent than has heretofore been supposed.

As the results of which we have been speaking were announced from time to time they did not pass unchallenged. The reality of the 427 day period was very promptly called in question on account of its supposed conflict with dynamic laws.

Prof. Newcomb, who at first ranked as a sceptic, soon found a very plausible explanation by assuming that the earth is not a rigid body as required by Euler's theory. The question whether the earth as a whole should be regarded as a rigid body has long been more or less an open one. Certainly the waters of the ocean introduce an element of mobility, but the investigations of Lord Kelvin and Prof. Darwin of the bodily tides in a viscous spheroid when applied to the earth, gave very little, if any, evidence of yielding in case of the latter to external forces.

Laplace had discussed with negative results the effect upon the earth's motion of the mobility of the ocean. (M.C., tome v. p. 76.) Euler's equations had been modified by Liouville for the case of a body which is slowly changing its form from

internal causes (*Liouville's Journal*, 2nd series, tome iii. 1858 p. 1), and these modified forms had been employed by Darwin in the discussion of the influence of geological changes in the earth's axis of rotation. (*Phil. Trans.* 1877, p. 271.)

No suspicion, however, seems to have entered the brain of any of these investigators that any modification of Euler's 305-day period would result either from the mobility of the ocean, or the elastic yielding of the earth as a whole.

Newcomb shows in a very simple manner how this result might follow (*Monthly Notices R.A.S.* March 1892, p. 336), for in consequence of this elastic yielding the pole of figure would be brought towards the pole of the instantaneous axis by the centrifugal force.

Let us call the undisturbed position of the pole of figure the fixed pole, the actual position at any instant the movable pole, and the pole of the instantaneous axis the pole of rotation. The movable pole is therefore constantly moving towards the pole of rotation, describing a sort of curve of pursuit; the instantaneous velocity of the latter about the former is that of Euler's period, but the effect of the motion of this movable pole is to diminish the velocity with respect to the fixed pole in the ratio of its distance from the latter to the distance from the pole of rotation.

Lord Kelvin remarks that this supplies a new and independent method of determining the effective rigidity of the earth. As will readily appear, in this distortion work is being done against resistance, and unless the earth be perfectly elastic, which is certainly not true of that part accessible to observation, the two axes would in time be brought into practical coincidence. The tidal action set up in the oceans would also tend to produce the same result. Apparently, then, the continued existence of this term requires a constantly recurring series of impulses.

Gylden remarks that the hypothesis of elasticity is not the only one which will explain the Chandlerian period. (Astronomische Nachrichten Band, 132, p. 193.) He also concludes as the result of a mathematical analysis that we must look for the impelling cause to concussions going on in the interior cavities of the globe.

Aside from the fact that these discussions are in need of explanation to an extent quite equal with that of the phenomenon itself, it is an open question whether any explanation is called for. We have no proof of the perpetuity of this term. We are in possession of no observations accurate enough to throw any light on this subject before the time of Bradley, nor can it be asserted that so small a coefficient has remained constant during the interval of 150 years; possibly it may be on the road to extinction.

As to the annual term, it seems to have no foundation in theory except as the result of meteorological causes, in which case we can hardly hope for more success in dealing with it than in predicting the weather on which it depends. For further improvement in our knowledge of this subject we must look to continued observation at a number of points carried on for this express purpose, and so conducted as to eliminate, if possible, all systematic errors. If, as seems probable, the coefficients—at least that of the annual term—partake of the erratic nature of meteorological phenomena, it will be necessary to keep this work up perpetually.

A plan is under discussion for establishing four permanent latitude stations on the same parallel of latitude, at intervals of 90° in longitude as nearly as may be. These will presumably be equipped with identical instruments of the most approved form, and the same stars employed at all of them. Until this plan, or some modification of it, is in working order—and probably for some time after—careful determinations at other points will continue to furnish valuable data, especially in settling the question of progressive changes, local or otherwise.

The instrument hitherto employed in special observations for this purpose is the zenith telescope. The possibility of determining latitude by measurement of the small difference of zenith distance of two stars properly situated—one culminating north, the other south of the zenith—was pointed out by Horrebow in his *Atrium Astronominæ* in 1732. (Wolf, "Geschichte der Astronomical," p. 608.) Possibly he may have made a practical application of the principle; if so, any account of it has escaped my notice. The method, however, was employed by Father Hell—otherwise not unknown to fame—in determining the latitude of his transit of Venus station at Wardoehume in 1769. He appears to have been unacquainted with Horrebow's previous suggestion, and determined his latitude in this way, as he says, from necessity.

The idea seems to have lain dormant until about 1834, when it was hit upon independently by Talcott in America, and Pond in England. The latter, in employing the zenith telescope—which had then been recently mounted at the Royal Observatory for the special purpose of observing γ Draconis—found that a fifth magnitude star passed the meridian thirty minutes later at nearly the same distance on the opposite side of the zenith.

By observing these two stars, reversing the instrument between them, he found certain advantages now well known to be inherent in the method. ("Phil. Trans.," vol. cxxiv. p. 209.) Pond states that the same method may be employed with Altazimuths, and other portable instruments, but the communication appears to have attracted no attention, and apparently he made no attempt to develop it farther.

In striking contrast is the immediate success which attended the employment by Talcott of an instrument constructed to carry out this principle. The first practical application of it was in 1834, in the survey of the northern boundary of Ohio. (*Journal Franklin Institute*, October, 1838.) Its merits were very promptly recognised by the officers of the U.S. Coast Survey, where it received a number of modifications and improvements suggested by experience, making it practically the instrument which we have to-day. It was many years, however, before it came into use to any considerable extent on the eastern side of the Atlantic.

To America undoubtedly belongs the honour of practically introducing this important improvement in latitude determination.

But although Americans practically introduced the instrument to the world, it was reserved to the Germans to teach us how to use it. It is due in great measure to refinements and improvements devised by German observers and instrument makers that the probable error of a single determination is now ·12″ or ·15″, instead of three times these amounts, with which we were formerly satisfied. The essential features of this instrument are the micrometer and the level. Unless these are of a high degree of excellence first class results cannot be obtained; especially is this true of the level, of which two are commonly employed with the best class of instruments. Only those who have experienced it are aware how difficult it is to procure levels of the necessary quality. Moreover, changes of form are liable to occur, rendering what was a good level worthless. The method so frequently employed by determining the value once for all, and continuing to use it for years without farther examination will not answer here.

This uncertainty of the level has led to devices for dispensing with it. One of these, which seems promising, is the floating Zenith telescope, invented by Fathers Hagan and Fargie. In this instrument the telescope, with its accessories, floats on the surface of a trough of mercury, the trail of the star as it crosses the field being recorded on a photographic plate, which may be measured at leisure. Possibly a way may be formed for making these exposures automatically, thus furnishing means for keeping a record continuous in so far as absence of daylight and of clouds will permit. With four stations established as described above, equipped with automatic instruments, data will be rapidly accumulated for settling the questions still remaining doubtful. It will not, however, be a work of merely one, two, or three, but of many years.

Is it too much to hope that within five or ten years we may see some such system as this in full and successful operation?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A PARLIAMENTARY paper has just been issued in which is given an abstract of returns furnished to the Department of Science and Art, showing the manner in which, and the extent to which the councils of counties and county boroughs in England and Wales, and the county councils, town councils, and police commissioners of police burghs are devoting funds to the purposes of science, art, and technical and manual instruction. The returns were made by these bodies in response to a letter sent to them in December, 1892, by the Education Department. Much of the information contained in them was noted in these columns on August 28 (p. 404). It is remarked in the present returns: "A noticeable feature with regard to the work of the

county boroughs is that many of the councils have either erected or decided to erect, technical schools, or have taken over existing schools, for the purpose of supplying technical instruction under their direct control, to which they have decided to apply the whole of the funds at their disposal, which in some cases include the proceeds of a rate levied under the Act of 1889."

AT the Cambridge summer meeting, recently concluded, a lecture was delivered in the hall of St. John's College, on the late John Couch Adams, by Dr. Donald MacAlister. The lecture gained in interest from the fact that Dr. MacAlister was a personal friend of the late professor, and was in consequence able to supply many interesting details as to his life. This was particularly the case when speaking of Dr. Adams' early training. Many know that Adams was a sizar of St. John's, but perhaps few realise what a strenuous course of self education had preceded his election. He taught himself algebra when a boy at his father's farmhouse in Cornwall, and prepared himself for Cambridge at a country school and at the local Mechanics' Institute. A curious entry is to be found in Adams' diary for June 26, 1841, during his second year at Cambridge: "Went to Johnson's (the bookseller in Trinity Street) and read Professor Airy's report on the state of astronomical science," showing, as Dr. MacAlister explained, that his interest lay in that direction at that time as at a slightly later date. In the Tripos it is well known that Adams was as far above the second wrangler, in an exceptional year, as the second was above the wooden spoon. In a surprisingly short space of time, by 1846, Adams became celebrated for his discovery of Uranus, but it may not be remembered that for a short time he was a Professor at St. Andrews. On his return to Cambridge as the Lowndean Professor, he became associated with Pembroke College, as from 1853 he was a Fellow there. The University, as a memorial, has undertaken the publication of his works, and a monument of some kind is shortly to be placed in Westminster Abbey.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 28.—M. Lœwy in the chair.—On a typhoon of last year in the China seas, by M. H. Faye.—R. P. Chevalier, Director of the Meteorological Observatory of Zi-Ka-Wey, has sent an account of the terrible typhoon of October 7-10, 1892, which led to the loss of the British mail steamer *Bokhara*, to M. Faye. A close study of the phenomenon has revealed the fact that there was no high-pressure area for a distance of 600 to 1000 miles round the centre. This result is entirely in opposition to Ferrel's theory which asserts that every cyclone is surrounded by a high pressure area representing an anti-cyclone. P. Chevalier is also convinced that in low latitudes cirrus clouds form a constant indication of a distant typhoon. According to him, the centre of a typhoon and its direction are indicated by the point on the horizon whence the cirri appear to diverge, an observation which would locate the origin of typhoons in the region of low-latitude cirri, *i.e.* at a height of about 1200 or 1300 m., instead of at the surface of the earth, as often supposed. But P. Chevalier believes that the interior motions of the cyclone are represented by rectilinear convergent trajectories curved by the rotation of the earth, so that the air ascends in all the phenomena, except at the centre, where even he does not go so far as to deny the descending movement so clearly observed by Manille. He observes, however, that the foot of the cyclone was lifted above the surface at intervals, to descend in another portion of its track, and that it was independent of the nature of the ground, thus characterising itself as a phenomenon originating in the higher atmospheric strata exclusively.—Chrono-photographic study of the different kinds of locomotion in animals, by M. Marey.—In order to photograph different animals in motion, reptiles must be placed in a sort of circular canal where they can run on indefinitely, the chrono-photographic apparatus being placed above this canal. Fishes are made to swim in a similar canal filled with water illuminated from above, so that they appear dark on a light ground, or from above, so as to appear light on a dark background. The principal difficulty lies in causing the animal to move in its natural manner. Some interesting analogies may be observed between simple creeping and more complex movements. An eel and an adder progress in the water in the same manner; a wave of lateral inflexion runs incessantly from the head to the tail, and the speed of background propagation of this wave is only slightly superior to the velocity of translation of the animal itself. If the eel and the adder are placed on the ground, the mode of creeping will be modified in the same manner in the two species. In both, the wave of reptation will have a greater amplitude, and this amplitude grows more and more as the surface becomes smoother. In fishes provided with fins, and in reptiles possessing feet, there remains, in general, a more or less pronounced trace of the undulatory motion of reptation. The grey lizard, when photographed at the rate of forty or fifty exposures per second, exhibits this clearly, and also reveals the fact that the mode of progression by means of the feet is diagonal, and analogous to trotting. This gives rise to an alternation of convexity and concavity in the body on each side.—On a property of a class of algebraic surfaces, by M. Georges Humbert.—On the third principle of energetics, by M. W. Meyerhoffer.—The new principle recently added by M. Le Chatelier to thermodynamics, to the effect that every form of energy may be decomposed into two factors, one of which is of a constant magnitude, was enunciated two years ago by M. Meyerhoffer in the following form: everything which takes place in the world consists of processes in which the different capacities change their potential without changing in quantity, where the two factors are the capacity (*Inhalt*) and the potential.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (April to June) contains the following papers of scientific interest.

April.—H. Weber: Researches in the Theory of Numbers in the domain of Elliptic Functions, III. Th. Liebisch: The Spectrum Analysis of the Interference Colours of Biaxial Crystals. G. Bodländer: Experiments in Liquids containing Substances in Suspension, I.

June.—Lazarus Fletcher: Remarks on the Catalogue of the Meteorite Collection of the Göttingen University. F. Kohlrausch and W. Hallwachs: On the Density of Dilute Watery Solutions (with diagrams). F. Hultsch: The Approximate Values of irrational square roots given by Archimedes (with diagrams).

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